SOFTWARE IMPLEMENTATION

A   IMAGE DISPLAY SYSTEM 511

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If you should venture to Idaho, and find yourself at the Idaho Department of Water Resources (IDWR), Remote Sensing Unit, you stand a good chance of hearing one of our senior management personnel say "you now only have to press the button, and presto, displayed in living color, an image that formerly took weeks to hand color."$_2$ This is the current introduction to International Imaging System's (I^{2}S), display device and software that a visitor at our site will receive. It is with pleasure, that I would like to relate to you some of our experiences with bringing System 511 on line at IDWR. Certainly our joys and suffering bear sharing with those who may be considering embarking on a similar endeavor.

Functionally, System 500 is the software package designed to drive I^{2}S's Model 70 digital display device. System 500, according to I^{2}S, is fully supported on 3 minicomputer systems. System 501 is based on the Hewlett-Packard 1000, System 520 on the Data General Eclipse. System 511, to which all further comments shall be addressed, is the I^{2}S version of System 500 designed to run on a Digital Equipment Corporation (DEC) PDP 11 Series minicomputer. It is fully compatible with the DEC operating system as delivered. According to the manufacture's specifications, the minimum system hardware configuration is an 11/34 with a minimum core of 128K word, 10 megabytes of direct access disk and a floating point processor. Required software configuration is RSX 11M V 3.2 operating system with a FORTRAN 4 plus compiler.

The structure of System 511 is a series of hierarchical modular software units. At the highest level, the user has available stand along hardware diagnostic interpreter and file manipulation routines, in addition to the interactive display software, the heart of System 511. The user communicates with the command interpreter, a string processor that interpretes command line syntax, and processes parameter requests. Command interpreter passes control to the application's program, which accomplishes image processing manipulations by utilizing a series of primatives. The primitives use a series of utilities and interface routines to properly set up the Model 70 display device sub-units. At the lowest level, data I/O is handled by device drivers. Both overall program control and data are passed through an 8K resident common block. (Figure 1). Included with the distribution is complete source code for all levels, to enable the user access for system support and maintenance.

The display system hardware/software, configuration settled on was that
which was thought to be most amenable to IDWR's current image processing
and overall data processing activities, with an eye for minimizing costs
and maximizing the use of existing hardware. In committing to System 511,
it was recognized that the current version (2.1), contained many defic-
iencies that would severely limit its application use. I^2S indicated
that an updated verison that would correct many of these deficiencies
would be available by the time we were ready to go on line in the spring
of 1980. However, Version 2.2 of System 511, was not available until
February, 1981, at an update charge of $ 750. At this time, e.g., this
writing, we were operating with Version 2.1 of System 511. It is our
understanding that some of the deficiencies discussed in this report,
have been corrected in Version 2.2. The extent of the correction is not
known.

IDWR operates a DEC PDP 11/34 minicomputer in a multi-user environment,
primarily for data entry and as a Remote Job Entry (RJE), station to
the state's IBM 370/168. This is the operating environment to which we
introduced System 511. The influence of environment on behavior is a
consideration that cannot be overlooked when evaluating our experiences.
While a well experienced data processing service organizaiton could handle
the installation of System 511 in short order, it was IDWR's fate to be
without systems programming support at installation time. The installa-
tion of System 511 software, due to the forementioned lack of systems
programmer support, provided the Remote Sensing Section with an excel-
lent opportunity to become thoroughly familiar with DEC utilities and
the operating system. This was our choice because I^2S stated that systems
installation was straight-forward and required no special training. On
site installation by I^2S is available for a fee.

Software distribution was in the form of tapes. A master indirect com-
mand file querries for system-specific configuration information, then
proceeds to build System 511. The installation documentation was limited
to the indirect command file which is liberally commented. This approach
is straight forward, however, nowhere in the installation, or any other
documentation will be found a list of all the DEC utilities required, or
the system options that must be enabled via systems generation (a time
consuming porcess in itself), prior to installation of System 511. As
a result, it took the Remote Sensing Section, several evenings to sort
out the what, where, and how's of the installation. I^2S was very sup-
portive at this stage with answers over the telephone.

After System 511 had been contracted, I^2S offered a 1 week software
training course, I^2S recommended that attendees be as familiar as pos-
sible with DEC's RSX 11M operating system. The Department's Data Proc-
essing Manager and 2 applications programmers attended the course. Due

to personnel turnover, none of these attendees is currently available for direct comment, hence my remarks concerning the training are second-hand, as I did not attend the course. Dissappointment was expressed that the DEC environment was not addressed, as we had been led to believe it would be. A major difficulty with the course was that the full perspective of the hardware/software interaction was not adequately addressed. The course began at the lowest level, examining bit settings. Then the course boot-strapped it's way up through the levels of System 511 to applications design with limited hands on experience. Without a precise foreknowledge of the Model 70's hardware and System 511 software functions, the benefits of this approach were largely lost. The I^2S software training course is designed for an attendee who is a programmer experienced in writing image display programs.

As a result of the lack of formal software training, our inhouse System 511 training has been limited to what could be gleaned from the documentation. As a result, we have leaned on it rather heavily. Documentation from I^2S consists of a series of brief volumes dealing with the display device hardware and System 511 software. Our perception of the hardware documentation is that it is complete, if not exceptionally readable. The user guide documentation for System 511 and the Diagnostic Interpreter, is adequate, but could certainly be improved. The user guide did have some verification and typographical errors that became apparent during system use. It is the applications programmer who is left holding the bag, the only documentation being the comments in source listing; there is no other. In addition, there is no error documentation.

It becomes readily apparent that I^2S fully expects the burden of software support to fall on the user, who is expected to be prepared to provide, or have access to, fully qualified system and applications programming support.

Software support from I^2S has been to date, limited by two factors. First, the time factor to access the appropriate person to direct questions to can be days. Once connected though, explicit, intelligent questions get concise, thoughtful answers. No fault there, however, the difficulty in specifically identifying the source of a problem is a limitation imposed by I^2S operating under the premise that the user will provide a high level of system-programmer support.

Error situations that occur during the operation of System 511, at IDWR, have fallen in three categories (in order of frequency), user induced, documentational and System 511. System 511 is characterized by error messages that are at the systems-support level, not user oriented. The

combination of poor error reporting and deficient or non-existent documentation complicates the process of determining the source of a problem. A person not familiar with the DEC operating system cannot successfully operate System 511, because of the lack of graceful error recovery and user level error reporting.

With a properly prepared display program, System 511 as delivered, is a very effective sales tool for digital image processing. Presentations on image analysis become more forceful and effective with the capability of rapidly displaying and changing video images, instead of pointing to the tired old hand colored computer printouts. Display capability adds an air of timeliness and a gee-whiz factor that is very effective and compelling.

When System 511 is not being utilized to demonstrate image processing capabilities to department visitors, System 511 does work well as a display system to augment IDWR's image processing capabilities with VICAR/ IBIS. When used correctly, System 511 performs the display functions smoothly. However, those functions fall far short of utilizing the full capabilities of the display device. Having worked with other interactive display systems, it is easy to forget the primary display design characteristics of System 511 and expect performance along the line of a larger system. It was our erroneous assumption to expect that when extra hardware features were ordered, you would also get complete software that could utilize the full range of the extended capabilities.

System 511 was not acquired as a "turn-key" system. It is our feeling that many of the short falls of System 511 could be overcome by the presence of a fully experienced, well qualified system programmer, fully knowledgeable on a DEC operating system. It was never explicitly stated, but we feel that I^2S expects the System 511 user to provide support at this level, and the burden of application program support and development rests with the user. Should you be prepared to provide this level of support, System 511 contains what appears to be an excellent foundation on which to build a very powerful applications tool.
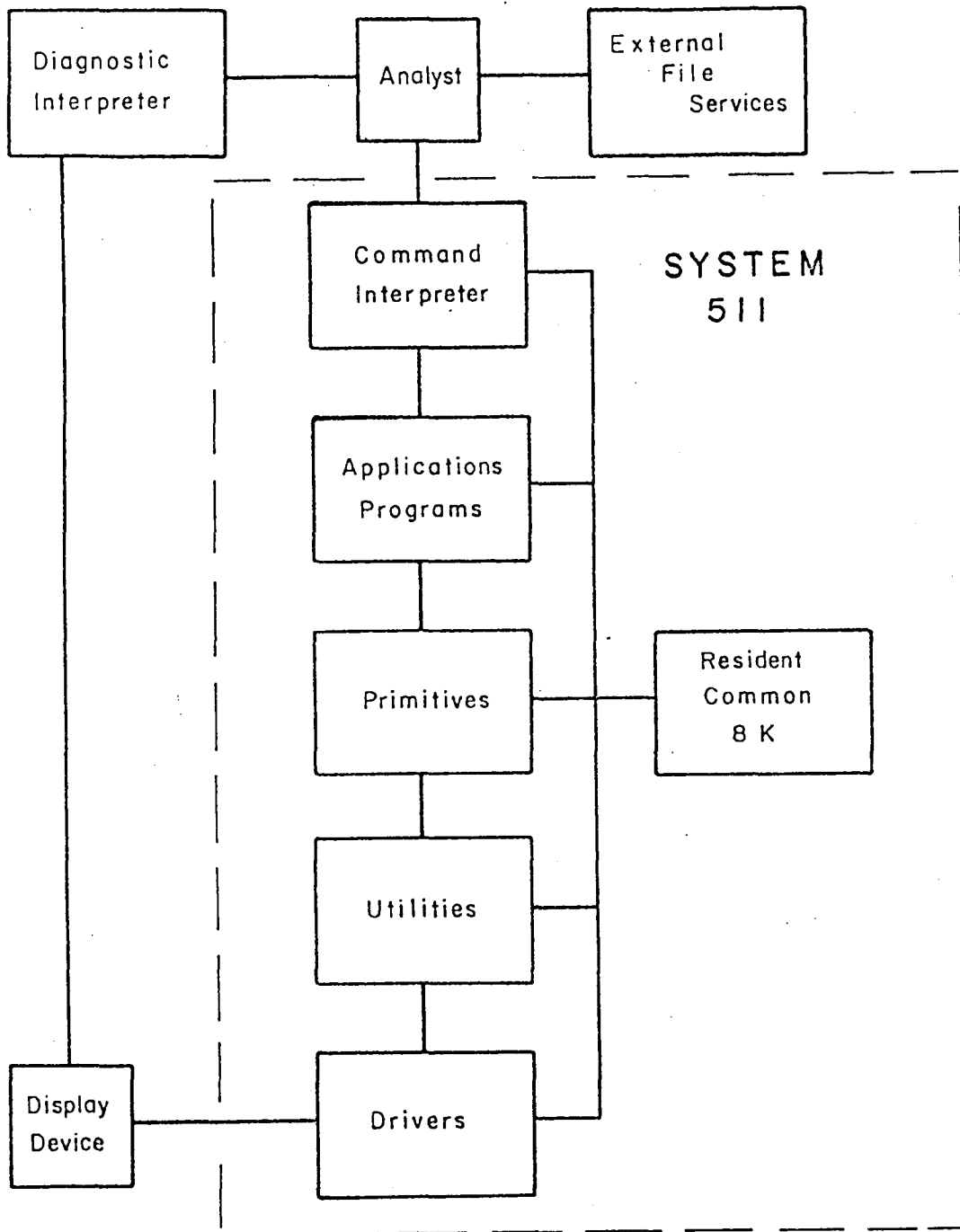
Figure 1   System 511 Software Hieracy Implemented by IDWR On
Digital PDP 11/24