C   VIDEO INFORMATION COMMUNICATION & RETRIEVAL/IMAGE
              BASED INFORMATION SYSTEM (VICAR/IBIS)

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Introduction

Washington State University Computing Service Center (WSUCSC), serves a
network of public agency users throughout the State of Washington, the
Pacific Northwest region, and other parts of the nation. At the Center,
we offer a wide variety of software services to our user community. In
1978, the Computing Service Center became interested in image processing
technology and with partial funding from the Pacific Northwest Regional
Commission (PNRC), and support from the National Aeronautics & Space
Administration (NASA), the VICAR/IBIS digital image processing system
was acquired and installed. This paper reports on WSUCSC's experience
with acquisition, operation and planning stages of VICAR/IBIS implemen-
tation. While we recognize that a service center computing environment
is in some respect distinct when compared to the non-user oriented facil-
ity, we believe that many of our experiences are appoicable in other
computing situations where VICAR/IBIS is being considered.

System Overview

The VICAR image processing system has been under development at Jet
Propulsion Laboratory (JPL), since the late 1960s. Initially designed
as an enhancement tool for data from unmanned interplanetary space mis-
sions, the system has since been applied to many diverse aspects of
digital image analysis including earth resource and biomedical research.
In addition to highly flexible image processing capabilities, VICAR
supports a set of geographic information system functions called the
Image Based Information System (IBIS). Based on enhanced information
retrieval capabilities, the resulting VICAR/IBIS software package is
uniquely powerful among other raster processing systems. Although
functionally quite strong, serious weaknesses have been identified at
the operational levels of system support and maintenance. These short-
comings will be described throughout the paper with references to
WSUCSC's responses to problematic experiences and future plans and re-
commendations.

In overview, the VICAR/IBIS software configuration (Figure 1), supports
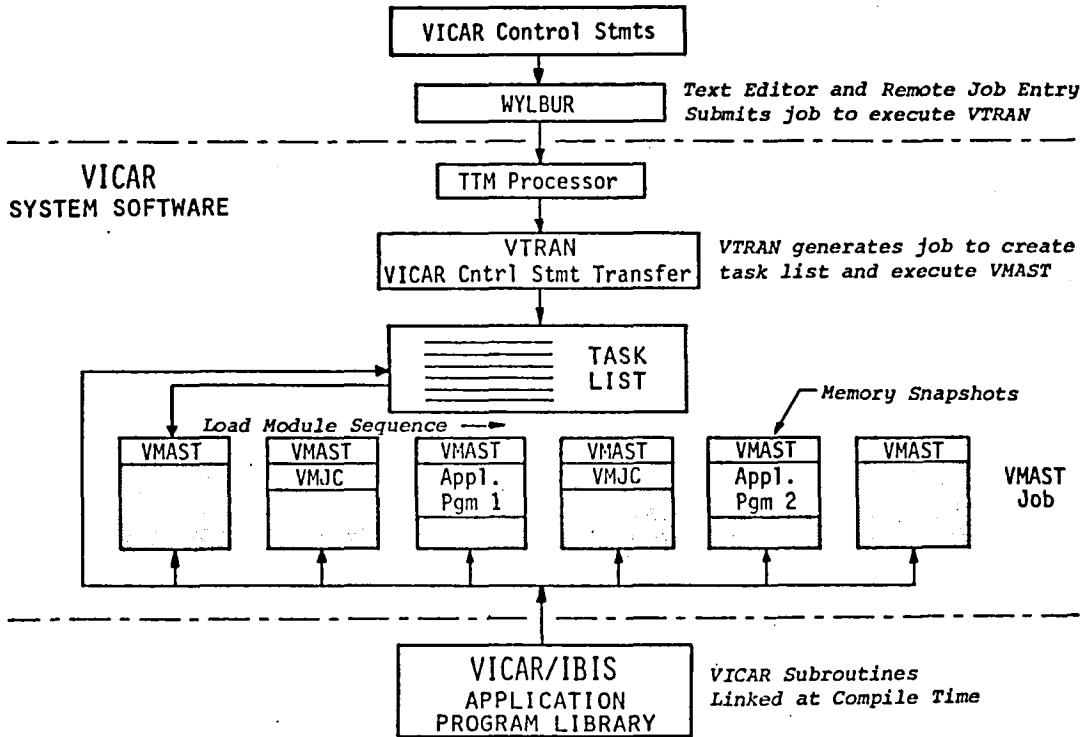4 major components which include —

Figure 1   Generalized VICAR/IBIS System Operation

- VICAR System Functions
- TTM Macro Language Library
- 300 Application Program Modules
- Primitive Image Processing Subroutines

VICAR system functions serve as an interface between the user and the operating system relieving the applications person of necessary expertise in Job Control Language. In operation, these programs translate VICAR Control Language, a set of user commands, into appropriate JCL parameters specifying the origin, processing to be performed, and destination of image data sets. Application programs are modular, general purpose functions which are selected, ordered and executed by the user in VICAR Control statements to perform specific processing strategies. The VICAR primitive modules, the subroutines, are called by application programs to perform repetitive image processing operations. The TTM macro language strengthens VICAR/IBIS with a recursive and iterative programming capability.

VICAR/IBIS has been installed as a mainframe, batch oriented image processing system at about 20 installations to date. Current system design characteristics have restricted installation to machines supporting IBM OS operating systems including virtual memory systems (Seidman & Smith, 1978). Although transfer to other computers or operating systems is possible (Lawden & Pearce, 1980), investments required in software modification and reprogramming may prove system transport unfeasible.

Acquisition & Installation

Being developed with public funds by NASA, VICAR/IBIS is normally purchased from COSMIC, the federal government clearinghouse, for about $ 1,600. System software is transferred on magnetic tape and includes —

- VICAR System Software Modules
- TTM Library
- Source Code for Application/Subroutine Program Modules
- Application/Subroutine Load Modules

Accompanying the tapes are —

- VICAR Image Processing System Guide To System Use
- Individual VICAR/IBIS Application Program/Subroutine
    Documentation
- Installation Guide (3 Pages)

Like many other image analysis systems, proper installation and use of VICAR/IBIS presupposes knowledge about computing, some basic image analysis concepts, and the system itself. During initial phases of system transfer and installation at WSUCSC, both JPL and NASA/Ames personnel were available to support the project. JPL made two offerings of a week long workshop, the second offering being video taped and made available through NASA/Ames. JPL personnel visited WSUCSC and the Idaho Department of Water Resources in Boise, a second Pacific Northwest VICAR/IBIS installation site, for system and applications debugging and training. In mid 1979, VICAR support personnel involvement shifted from JPL to NASA/Ames where it has continued since that time. Ames personnel presented a 4 day Introductory VICAR Workshop in October, 1980. Each of these training sessions presented topics including —

- The VICAR System Configuration
- Use of VICAR Control Language
- Basic Image Processing Concepts
- Specific Aspects of Earth Resource (Landsat) Applications

Attendees have reported that training handouts have been invaluable reference materials tin subsequent use of VICAR/IBIS. None of the workshops addressed specific problems involved in VICAR system installation.

VICAR/IBIS was acquired at WSUCSC in September, 1978. Center personnel had completed the first JPL workshop offering but otherwise were completely inexperienced with image processing technology. Following installation guide directions, one full time programmer versed in IBM utility programs, IBM JCL and FORTRAN successfully installed the system in 14 days. This process was not trouble free. Track size on WSUCSC's IBM 3350 and Braegen Calcomp 4350 disks were too large for VICAR system blocking conventions. Software modification was supplied by NASA/Ames and has now been permanently implemented in VICAR. VICAR tape handling routines require NL or BLP tape label processing parameters which may be regarded in many computer installations as a compromise to tape security. A tape management system utilized at WSUCSC compounded this problem. Tape security policy modifications were necessitated before addressing VICAR/Tape management system incompatibilities. While VICAR was operational without tape system modifications, it was exceedingly cumbersome to use and a resolution of the problem dragged out for nearly a year and required a commitment of about 1 programmer month. Finally, plotting software was not included in the transfer due to its proprietary nature. Although this problem is now nearly solved at WSU, it is foreseen that plotting software implementation will cause unique problems at future VICAR/IBIS installation sites.

Operational Considerations

In the 9 months following installation, WSUCSC personnel used VICAR/IBIS in a Spokane County Landsat project for demonstration and verification of system utility. Throughout the course of this project, Center programmers found time and time again, that when VICAR/IBIS ran, it ran beautifully, but when a program failed, identification of the problem and debugging were nearly impossible. Closer inspection showed that by even the most lax WSUCSC program support standards, VICAR/IBIS was far from being an easily maintainable system. Although support and maintenance guidelines are demanding due to the Center's responsiveness to user satisfaction, WSU programmers believe that the production problems encountered with VICAR/IBIS would cause potential maintenance difficulties at nearly all installations.

Most critical among VICAR/IBIS support problems has been the occurrence of a missing source and/or documentation component from otherwise complete program or subroutine modules. It should be clear that when source code is missing, program debugging, modification and enhancement is impossible. When documentation is absent, the program function must be interpreted from source code (if available), or the program is never used. A more subtle, but nevertheless critical, problem has been that occasionally an application program is found to have functionally uncorrelated load, source and documentation components. In other words, each of the components, when transferred, represented the developing, but operational, algorithm at a different stage of evolution. Several of these uncorrelated occurrences have put serious doubts about the integrity of other VICAR/IBIS programs in the minds of WSUCSC image processing personnel. Lack of available JPL VICAR maintenance documentation and the absence of internal date flags in program modules has made solutions to these problems complex.

Further practical problems with VICAR/IBIS have been identified at WSU. Some of these are as follows —

- Partial Nth generation xerox program documentation – unintelligible
- TTM macro language documentation not transferred
- VICAR abend code documentation is brief and nebulous in places
- Relationship of system abend codes to VICAR jobs is not clearly documented
- Much of the VICAR/IBIS documentation contains outdated information
- Insufficient documentation on program restrictions and timings

- No functional program menu - applications persons must search through all program documents to find appropriate processing function
- Internal software documentation often poor
- Internal software generation and modification dating generally non-existent
- No complete VICAR programmers guide available

While genuine concerns regarding software maintenance and documentation have been generated at the Center, overall impressions and acceptance of the system by WSU staff and Center users has been favorable. Currently running on the Amdahl 470/V 8 under the MVS/VS2 operating system at WSUCSC, staff members and users have become very comfortable with VICAR/IBIS batch job submission via the WYLBUR text editing, remote job entry system. WYLBUR software has been written to reduce VICAR/IBIS job submission and control to a series of user responses to terminal prompts. Several users have made a transition from interactive image processing to the VICAR/IBIS batch environment with differing degrees of comfort. All, however, recognize the advantages of mainframe image processing systems, especially when applied to large amounts of image data and/or complex raster algorithms.

WSUCSC VICAR/IBIS Support Plans

WSUCSC has made a commitment to support VICAR/IBIS as its main digital image analysis capability. To bring the system up to Center support standards, work has begun and is being planned in the area of —

1   System software cleanup & enhancement
2   Identification/compilation of an easily maintained set of application software
3   Redocumentation, reprinting of existing documentation & development of additional documentation
4   Organization of VICAR/IBIS users group for interchange of technical information between users & installations
5   Development of VICAR/IBIS image processing training for WSUCSC and others

Scheduling and personnel time investments associated with the VICAR/IBIS support effort are presented in Table 1. Each of the support areas will be addressed more specifically in subsequent paragraphs.

System software is one aspect of the VICAR/IBIS package which reflects the long evolutionary development of the system as a whole. Certain commands and options in the VICAR Control Language have not been used

Table 1   Personnel Time Estimates for VICAR/IBIS Installation
                & Support

Getting VICAR/IBIS Operational
 WSUCSC Personnel Training
 System Acquistion
 System Installation
 System problems debugging

Total personnel weeks 18

Accessing VICAR/IBIS Via WYLBUR 2

Program Debugging Due To
 Application Program Bugs
 Inadequate Documentation

Total personnel weeks 16

Current And Future Efforts To Bring
VICAR/IBIS To WSUCSC Support Standards
 Software Modification
 Documentation
 Training

Total Personnel Weeks 120-160

for years due to functional duplication with more recent application programs. Other commands have different names but identical functions. Center staff have identified and removed functionally synonymous command names and functionally outmoded command options leaving a more concise VICAR Control Language set.

In the course of VICAR/IBIS applications and testing at WSU, application programs have failed on occasion. In many cases, program repair was apparent with a little searching by Center staff, in other cases missing or out of date source code prohibited debugging. During this period, NASA/Ames was timely and expert in supplying program fixes when required. Nevertheless, wherever the origin of software modifications, the net effect was like fighting spot fires. As soon as one was extinguished, another was discovered. This type of software maintenance results in an endless effort and does not constitute a supportable system by WSUCSC standards. A decision was therefore made to rebuild the applications software portion of the system from the base up. Center programmers have now begun an effort to recompile all VICAR primitive routines from the latest source code transferred, obtain or rewrite any missing primitives called by a group of application programs designated for support. Recompile that group of application programs from the most recent source code transferred. The completion of this effort will leave WSUCSC with internally maintainable application software from the standpoint of in-house debugging, modification and development of programs.

System support is certainly lacking by any standards without adequate documentation. While solutions to all VICAR/IBIS documentation problems are complex and time consuming, the WSU Computing Center staff have been working on several critical deficiencies and have plans to address others soon. With funding from NASA/Ames, a new version of the VICAR/IBIS Reference Manual is near completion, incorporating the WSU version of VICAR Control Language. Application program documentation is also being reprinted and in some cases redocumented. It is anticipated that through a process of WSUCSC user feedback, VICAR/IBIS documentation can be fine-tuned and expanded for application programs supported by the Center. A VICAR Installation Guide and a VICAR Programmers Guide are planned for in the future.

Throughout the process of VICAR/IBIS transfer, installation and application at WSUCSC, close contacts were established with other installations where the system had been or was being installed. Sharing of technical information and software enhanced the systems and VICAR/IBIS understanding for those involved. As a result, it has become clear that there is not one but many different versions of VICAR/IBIS, and no two are probably the same. To some extent, individual computer system requirements necessitate certain unique system modifications. However, major

distinctions between systems lie in different sets of software and documentation. WSUCSC feels the deficiency of a users group by which information and software could be disseminated. The Center plans to establish such a group in the future and invites all interested parties to contact us.

Finally, essential to successful VICAR/IBIS image processing is good training. With matching funds from PNRC, WSUCSC developed one day overview seminars and 5 day hands-on workshop sessions to aid in the understanding of basic image processing concepts and VICAR/IBIS application. To date, this training has met with much success. The future holds continued offerings of training and course diversification into specific application fields and image processing techniques.

Summary

VICAR/IBIS is functionally a sound system. Operating in an IBM mainframe environment, VICAR/IBIS provides for efficient image processing especially when dealing with large raster data sets. Processing strategies are limited in scope only by applications programmer imagination. Although easily installed and operational within weeks, VICAR has presented WSUCSC with a variety of system support problems. Software and documentation situations at the basis of these problems occur at all sites of VICAR/IBIS installation. To what extent maintenance difficulties will affect computing operation at potential installation sites, depends on highly variable facility characteristics. VICAR/IBIS is in no sense a turn-key system. Those considering VICAR/IBIS installation should be prepared to invest significant personnel time and funds toward system upkeep as a dedicated system maintenance service is not offered at this time.