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Control System of SPring-8 Injector LINAC

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Abstract

In the present accelerators, it is necessary for us to construct the advanced control system. Because the beam specification is requested to get higher quality. The SPring-8 injector LINAC, will be completed in 1996, has also some requirements and future plans which except for the injection. Whatever requests, the control system have to keep up with a efficient improvement. It means that the control system must be constructed a flexible one. In this case, we have carried out the LINAC control system in accordance with the present state of the Software Technology [1].

In this paper, the status of our software project which accord with the Software Technology is described.

1 INTRODUCTION

Figure 1 shows the present state of Software Technology. The system of until 1990's have discussed one's problems which like as follows.

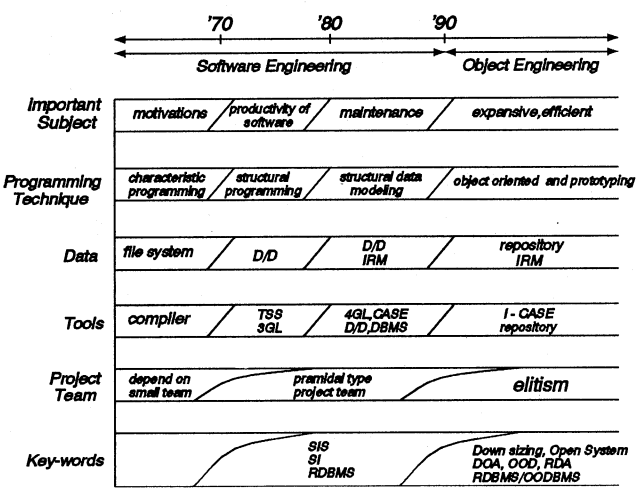

Figure 1: Present State of Software Technology

- **Closed System Environment:** The hardware and the software in the system depend on the supply of industrial makers. On these system, it is so robust that we have a hard time of maintenance.

- **System Design using Process Standard:** In many case, revisions happen in the software process logics, but most of processes intertwine with other processes. So revisions of software are difficult. We have a hard time of maintenance, again.

- **Inconsistent Project Team:** The system that is imagined by designers, programmer and coordinators differ from the ideal system that is imagined by users. When the system operate, many users will complain about it. Until the system operate, the project staff have to play a designer, programmer, coordinator and user. In the 1990's, the project have to be a elitism.

Now, the Object Engineering has become the mainstream. This is good approach to the above problems. And it introduce Data Oriented Approach(DOA). This approach is based as follows.

- The fundamental data in the system is stable. Compare with the system process, almost one's data do not rearrange. It is effective that the data is standardized.

Our software project suits the using DOA. Because the LINAC component process, called Object, will replace many times for the beam requirement, however almost fundamental LINAC data do not rearrange. We have carried out the LINAC control system in accordance with DOA.

2 DATA ORIENTED APPROACH

2.1 DOA Framework

Figure 2 shows the framework of DOA. (a) is the general DOA framework for business, and (b) is SPring-8 LINAC DOA framework [2]. At the general, many problems in the system are able to be stored on a operation. However our project is new one, so it is difficult to expect and pick up all the system problems. (Whatever happens, on the commissioning etc., the system problems have to be recorded and be reflected in next revision.) On DOA, the modeling is based on the picked up problems. Our DOA is shown next section.

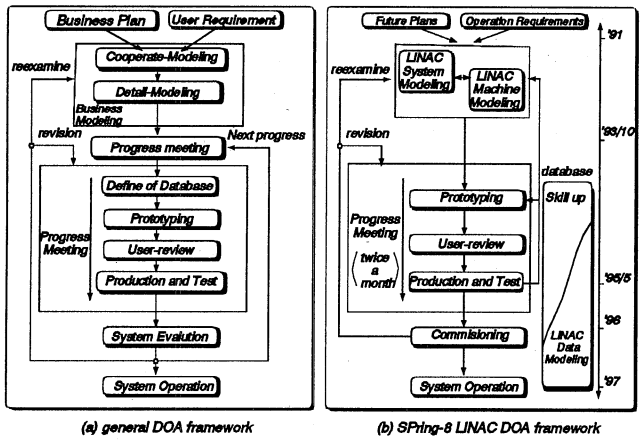

Figure 2: Data Oriented Approach framework

2.2 *LINAC System Modeling*

In general DOA framework, "Cooperate Modeling" means examining of the system problems, and make a rough system modeling. It means the same as "LINAC System Modeling" in our DOA. We think that the our control system problems as follows.

- **Computer Network speed and reliability:** The LINAC control data have to send quickly and reliably.
- **High portability of hardware and OS:** The system have to be quick to adapt to the trend of hardware and OS on VME's.
- **Flexible control system:** Whatever requests, the control system have to keep up with a efficient improvement.

As a solution to these problems, we got three keywords in the process of "LINAC System Modeling". They are, Communication Process [3], C language Device Drivers [4] , and Object Oriented Programming (OOP) [5]. At the follows modeling, they are modeled the details.

2.3 *LINAC Machine Modeling*

This modeling make the keywords the details.

Communication Process : Assuming that Linac is constructed by similar simple components, we got unification command of constructed all devices. That is SPring-8 LINAC machine Control Commands (SCC). Further, every behavior of all devices is also standardized in SCC. We think that SCC is the most stable data in our system and SCC is the standardized message for communication between objects. So, whatever we start to think, SCC is based on one's discussion.

For Network speed, we selected the connectionless type Network protocol. The connectionless type service(UDP/IP) has smaller over head, and it is faster than connection-type(TCP/IP) service in our traffic condition. But it will happen that transport error, loss of packets and mistake, because of the ease of error check in UDP/IP. It is necessary to reinforce the error check. So it motivated us to develope the SPring-8 LINAC machine Control Datagram (SCD)protocol. The Communication Process play to send SCC through the our Network protocol SCD. And the Communication Process is interface of EWS and VME.

C language Devive Drivers : When the VME CPU board power and Operation System (OS) do not reach the user's requirement, the system have to be quick to adapt to the trend of hardware and OS on VME's. We must consider high portability of hardware and OS. Figure 3 shows the example of modification of CPU boards. If Device Drivers of constructed VME system are written by Assembler language, when CPU boards are modified high power CPU, all Device Drivers have to be also modified. Because Device Drivers by Assembler language correspond only one CPU. We tried Device Drivers by C language. So that, when CPU boards are modified high power CPU, we will modify only an interface part by Assembler language. The system will get high portability of the hardware and OS.

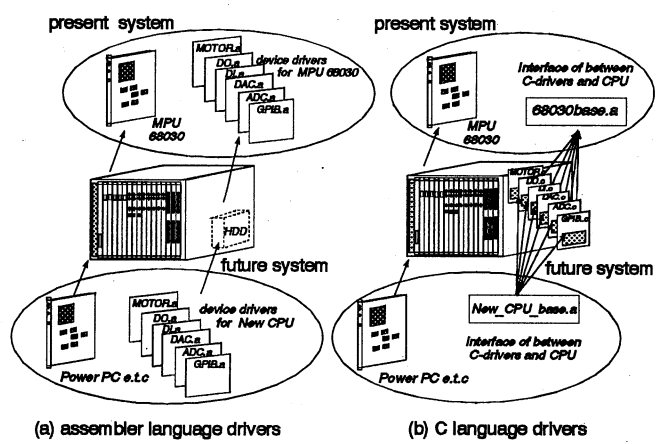

Figure 3: modification of CPU board

Object Oriented Programming : For the expansive and efficient at the system, OOP is adopted. First, we design the Super Class "MACHINE" that is core of Object. Figure 4 shows the Super Class "MACHINE" and the Sub Classes of it. Main attributes of "MACHINE" are the "parameter and status" and the "Behavior". The "parameter and sta-

tus" means the operation elements of Object, and the "Behavior" means the transitional status of Object standardized by SCC. So that, the Super Class can recognize SCC. The Super Class is inherited to Sub Classes.

These Object is constructed on VME software

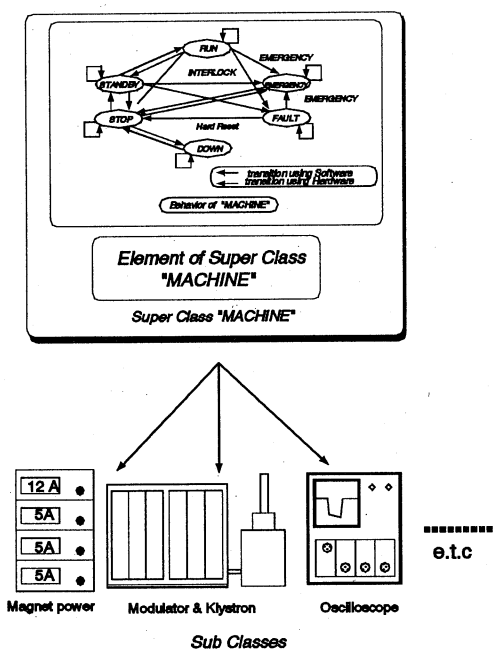

Figure 4: Super Class of LINAC

which like figure 5. As the LINAC hardware component and Object in the VME are in a one-to-one ratio, if the LINAC hardware component, GUN etc., is replaced, Object in the VME is also replaced.

2.4 *Prototyping and Test*

At our system using DOA, the modeling designer, coordinator and programmer is not a same person. So the designer showed prototype software which is reflected modeling. The programmer read the prototype source software, and understand it's modeling concepts. At the same time, the designer and coordinator explained to the programmer the constructed LINAC devices and it's operation. The programmer understand the user's concepts, too. This flow repeated several times. The software that is imagined by programmers became more and more like the designer's image.

3 CONCLUSION

The software project in our system, it is quite large, should carry out the using DOA.

We have SCC which base on our common concept. It is getting easy to model the system. And, we could make efficently the software which is imagined by

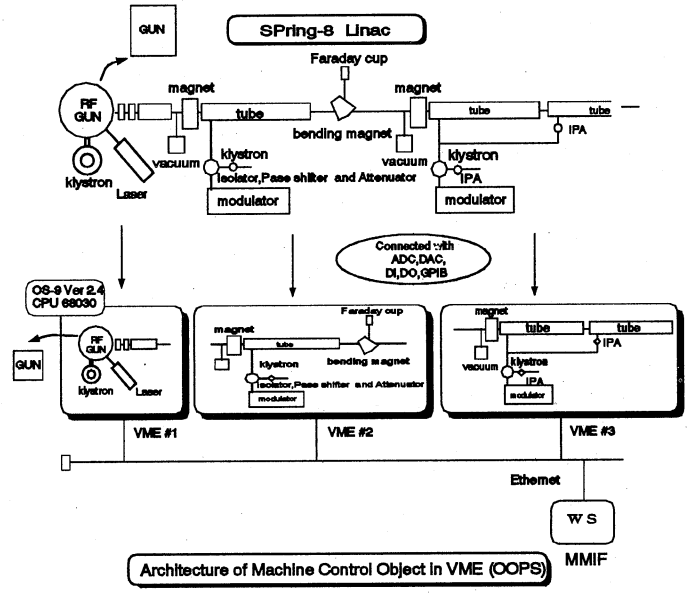

Figure 5: Construction of LINAC using OOP

designer and coodinator. When the operation start, the system will happen many problems and troubles, because of new system. However the system will be able to correspond flexibly. Next step, we have to model for database in accordance with DOA.

4 REFERENCES

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