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A methodology to develop parallel application applied to acoustic cancellation with genetic algorithms.

There are different diagramming techniques to develop mono-processor commercial software: data flow diagram (DFD), functional decomposition, Warnier-Orr diagram, flowchart, Nassi-Schneider action diagram ER,etc. Their application into conventional processing and with relational databases were largely studied and automated [1] . The main feature is the presentation of data flow and processing sequence.

Yourdon began to develop a graphic methodology, pointed to the inadequacies of a purely data-flow oriented approach to real-time systems designs [2] .

Parallel algorithms were presented into structured English [3] with a hard view of critical processing situation.

Our proposal is the definition of some rules and primitive symbols to design real-time parallel software, where resources contest, CPU waiting and deadlocks are under control and visible to the programmer. They represent the data flow, state sequence of each processor and the interaction between the processors into the parallel real-time processing.

Transaction diagram.

A computer program is an ordered sequence of statements and procedures to answer to external events. A processor changes its state continuously, and each state is associated with a transaction.

The transaction diagram is a graphic presentation where each state is specified and its processing is detailed into the horizontal way, beginning into the state definition and finishing into the conditional flow control. Vertical flow occurs only with conditional flow control. Fig. 1 shows each symbol and its meaning.

The genetic algorithm applied to acoustic cancellation.

The evolution and improvement of life occurs through reproduction, when each individual contributes with its own genetic information building a new one with fitness to the environment and more surviving chances.

Acoustic cancellation is established into the superposition principle, where two waves with different phase can cancel themselves.

With the objective of obtaining the sound components to be used for the cancellation of undesirable noise in the interior of ducts, a computer software which mimics the genetic process was developed. Each ‘individual’ of the generation represents a signal component with a different frequency, phase, and amplitude. It creates a population randomly distributed and evaluates the fitness of each individual. The best individuals are selected, and crossover and mutation take

place. Following few generations, the population converges to the mix of components that better reduce the acoustic noise [4] .

Hardware and software configuration.

The experimental setup consists of a rectangular 18' long duct, with speakers to generate noise and the canceling signal. The computational hardware is mounted into two levels: one TMS320C32 to data acquisition and pre-processing (ADC64-Fig. 2), and three TMS320C44 to run genetic algorithms (PCI44-Fig.3). The communication between the levels is through PCI bus.

Conclusions.

The transaction diagram used to develop genetic algorithms to run into a parallel real-time architecture can help the designer to better manage the software resources avoiding critical points.

A diagnosis program will be developed to check the performance of the software in real-time processing.

The graphical interface allow an easy optimization and common routines visualization of the software. The documentation is quickly updated and very condensed: Fig. 2 and 3 software was coded into 3.000 lines in C language.

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Bibliography.

[1] Martin,J.;McClure,C; Structured techniques for computing.

[2] Ward,P.;Millor,S.; Structured development for real-time systems.

[3] Akl,S.;The design and analysis of parallel algorithms.

[4] Sotelo Jr,J.; Bistafa,S.;Werner,J.C.;Castro,E.R.;Giorgi,R.C.; Active acoustic noise control in ducts and in 3-dimensional enclosed space; 13th U.S. National Congress of Applied Mechanics-1998.

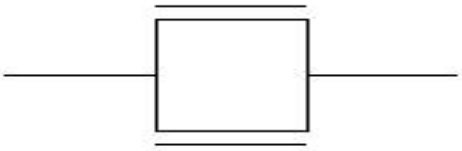
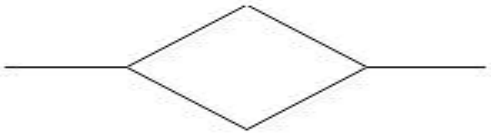
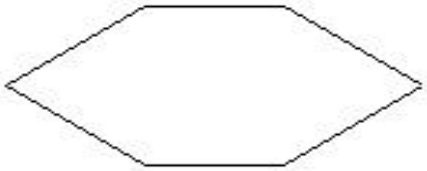
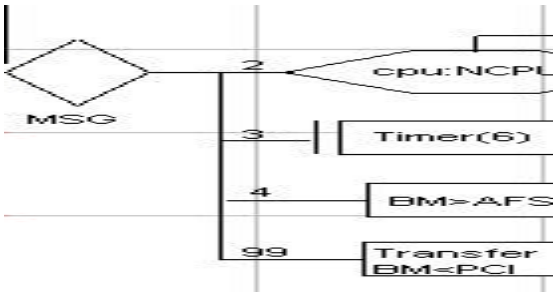
Symbol	Description
	Independent process: a set of statements executed by one or more CPU independently.
	Dependent process: a procedure executed by only one peripheral or CPU. It is a queue source.
	Syncronism between processors: a wait point into the processing flow.
	Conditional detour: selection of the transaction associated with a state.
	Repetition loop: inside the transaction, show the loops of the transaction processing: do steps I to j in parallel for i=j to k do in parallel for i=r,s,t... do in parallel
	Process: a complete function into the processing.
	Vertical lines: only to or from conditional detour.
	Horizontal lines: shows with detail the processing of each state.
> <	pipe values.

Fig. 1: Primitives definition to build transaction diagram.

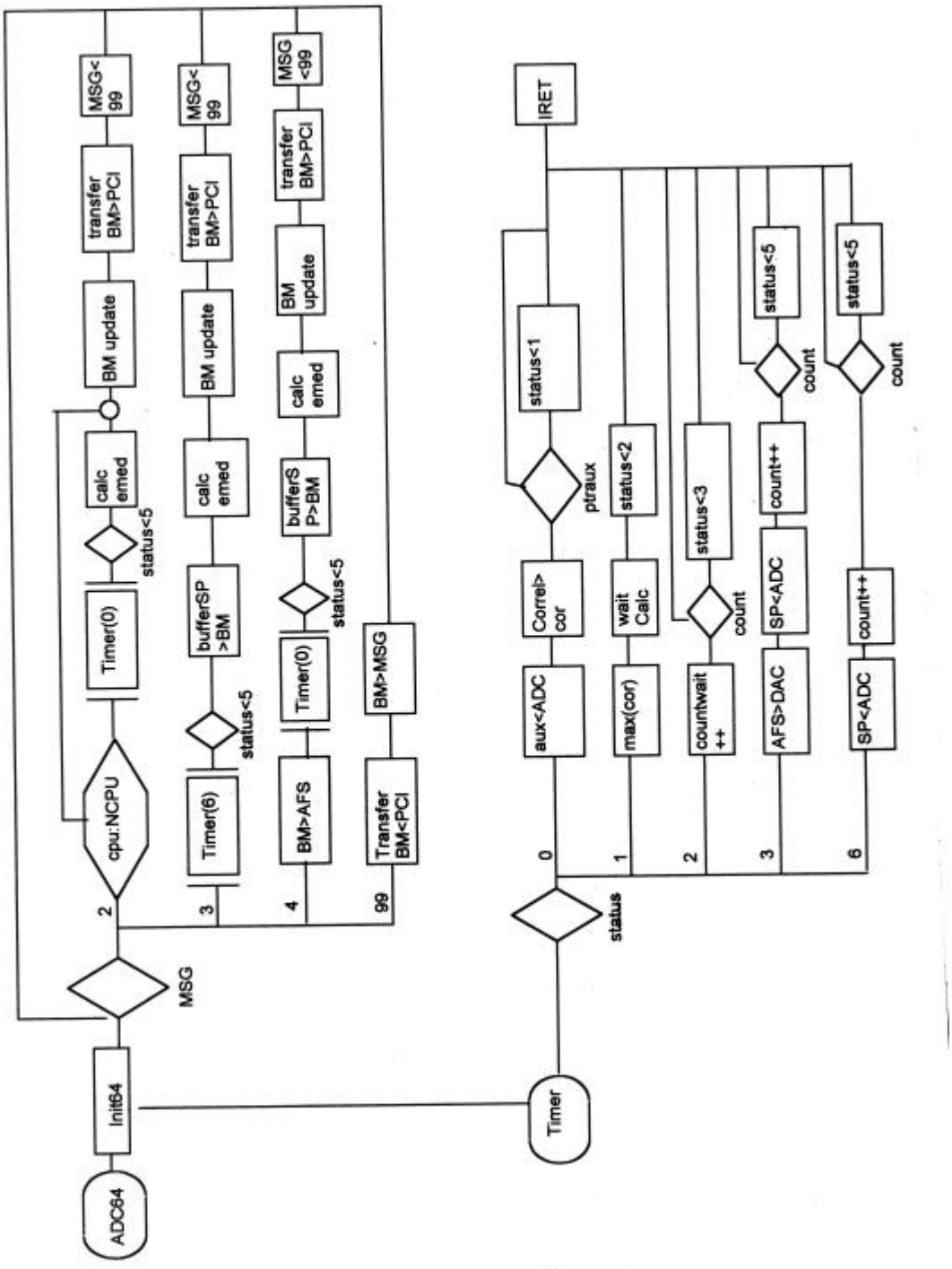


Fig.2 Transaction diagram to the acquisition system (ADC64).

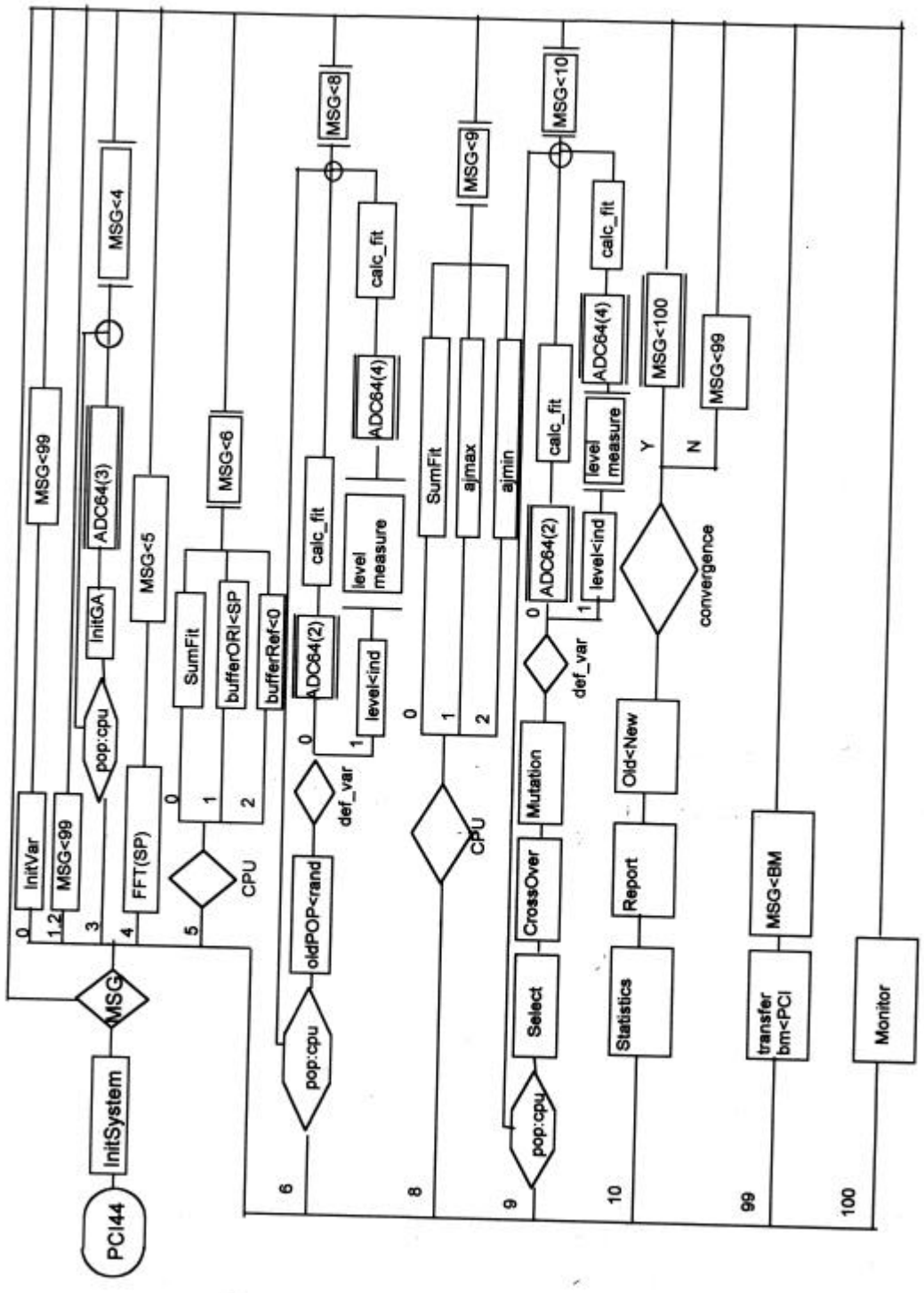


Fig.3 Transaction diagram of parallel system running genetic algorithms.