SGS-THOMSON MICROELECTRONICS

fuzzyTECH™ ST6
Explorer Edition

FUZZY LOGIC DEVELOPMENT TOOL FOR ST6

DESIGN:

■ System : up to four inputs and one output

■ Variables: up to 7 labels per input/output

■ Rules : up to 125 rules

ON-LINE OPTIMISATION:

■ Real time visualisation and modification

■ Data recording

OFF-LINE OPTIMISATION:

■ Transfer plot: redundant or unstable rules

■ Debugger: real time treatment from PC

■ Time response: time plot of input/output

■ Simulation: analysis of a built-in model
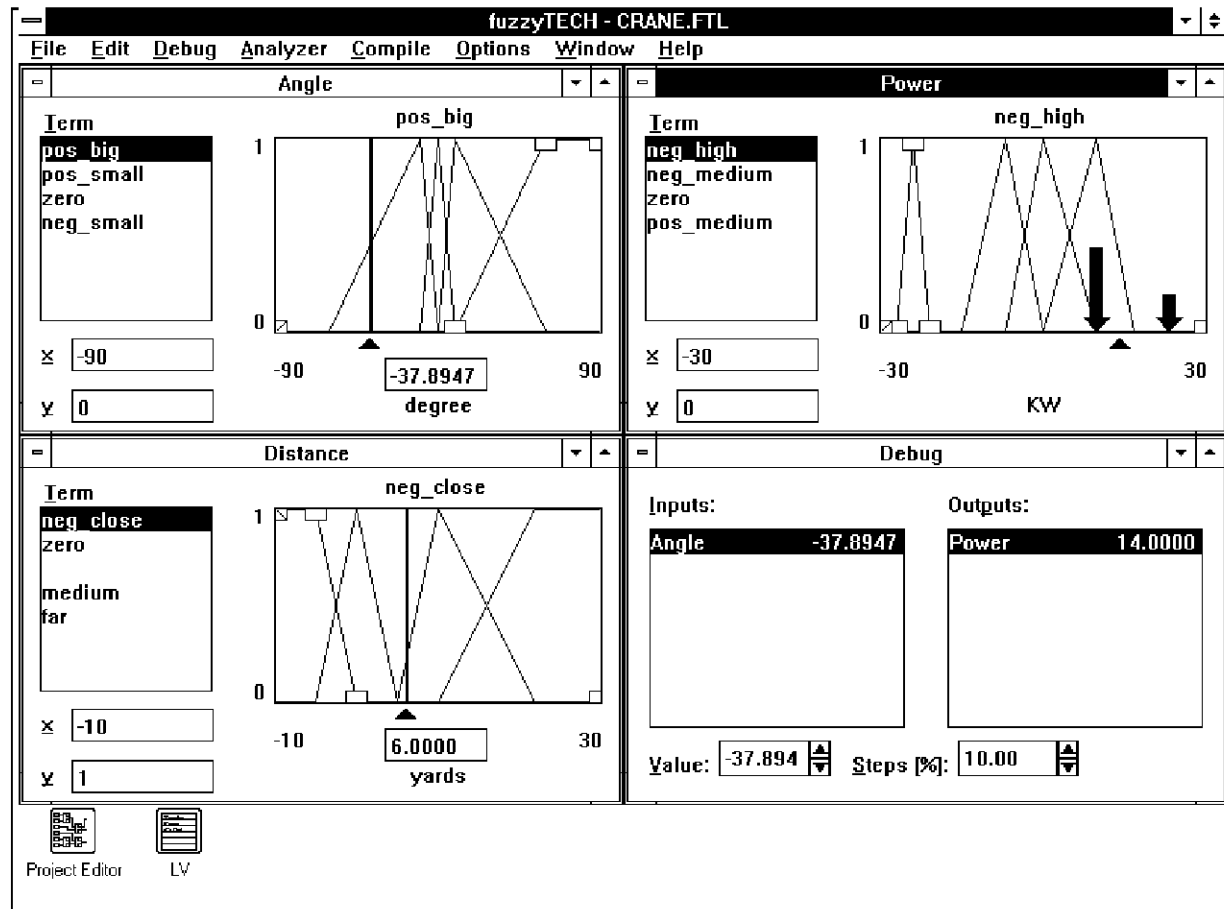
CODE GENERATOR:

■ Optimised ST6 assembly code

■ No licence fee

USER INTERFACE:

■ "point & click" tools MS-Windows™ compatible

PERFORMANCE (typical) :

■ 7 rules / 2 inputs/ 1output 10ms
  580 bytes ROM - 30 bytes RAM

■ 20 rules / 2 inputs/ 1output15ms
  670bytes ROM - 34 bytes RAM

DESCRIPTION

fuzzyTECH ST6 Explorer Edition is an easy to use, high level software development tool optimised for the design of fuzzy logic controls with the ST6 microcontroller. It covers all the steps of a fuzzy logic design from the initial concept to the production of optimised ST6 executable code. In addition, its MS-Windows™ based interface takes full advantage of the intuitive approach of fuzzy logic to define and optimise the control with a very friendly approach. These features enable the fast development of optimised control.

Figure 1. A development flow chart

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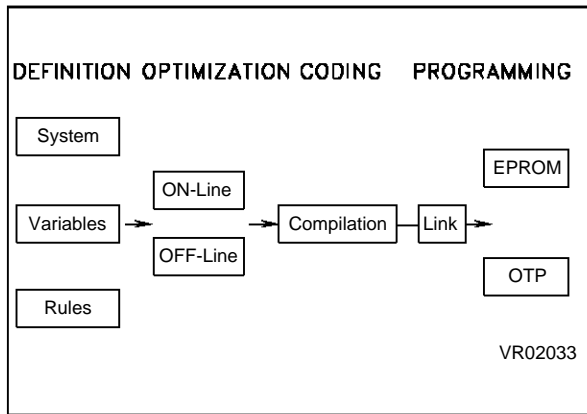
THE GRAPHIC DESIGN EDITORS:

FuzzyTECH ST6 Explorer Edition includes three graphical editors for the definition of the system structure, linguistic variables and rules generation. The resolution is 8-bit for all internal and external data. These editors enable definition of the complete system with graphical tools using a "point & click" approach.

System:
- Up to 4 input variables per module
- 1 output variable per module
- Fast computation fuzzification method

Variables:
- Up to 7 terms per variable

Rules:
- Allows up to 125 rules
- Full graphical input with matrix or spreadsheet
- Supports standard Max-Min inference method

Figure 2. Design Screen Examples

Example of System Architecture

Example of Variable Definition

Example of Rule Generator

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THE OPTIMISATION TOOLS:

fuzzyTECH ST6 Explorer Edition provides several optimisation tools using real time data coming from the application or simulations of the system behaviour. The generated files can be treated with the graphical tools of fuzzyTECH or with other software running on a PC.

On-line optimisation:

- Real time visualisation and modification (serial debug mode):

This mode enables the visualisation and modification in real time of the fuzzy logic algorithm configuration from a PC. In this mode, the fuzzy logic algorithm is treated by the PC. The ST62 program includes the application interface and the PC interface protocol. An RS232 link provides the interface between the PC and the ST62. The optimisation tools of fuzzyTECH can be used in real time in this mode. This option can be used in applications with a dynamic operation of typically 100ms or slower.

Figure 3. Task sharing of the serial debug mode
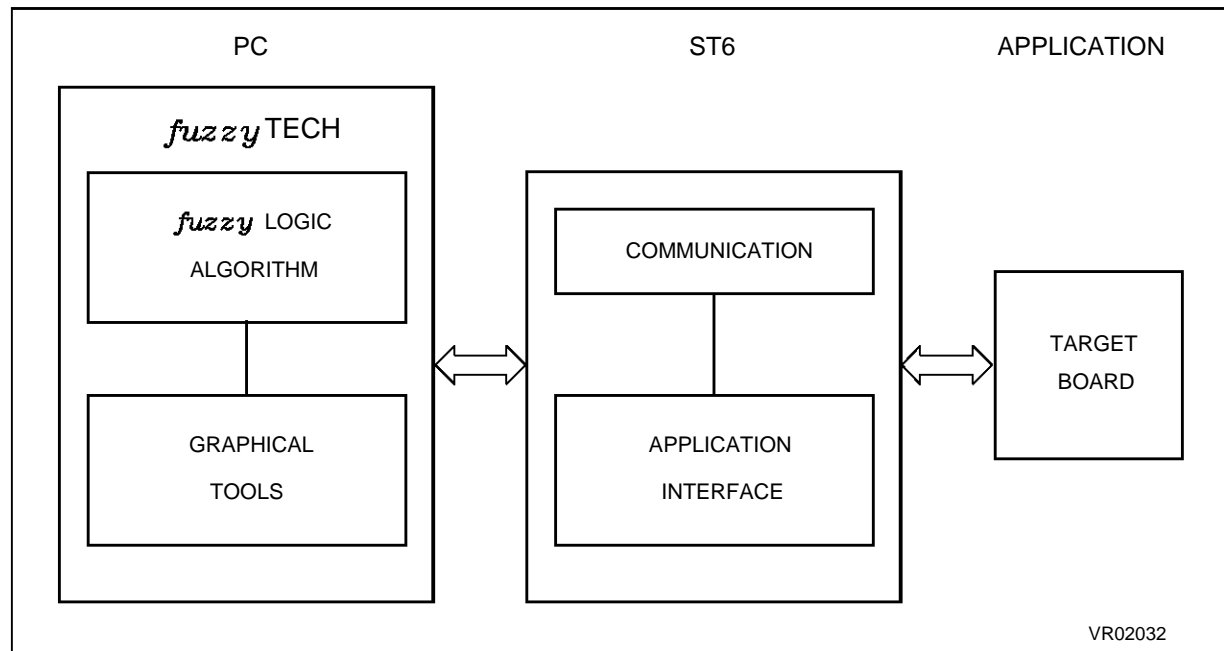
THE OPTIMISATION TOOLS (Continued)

- Data recording (file mode):

This mode enables the recording of input and output data coming from the ST62 in a PC. In this mode, the fuzzy logic algorithm is treated by the ST62 microcontroller. During each fuzzy iteration, the input and output data of the algorithm are sent by serial RS232 or a parallel port to the PC. This data can be used later inside the fuzzyTECH program or in any other software to visualise the control performance. This mode can be used in applications requiring a dynamic operation faster than 100ms.

Figure 4. Task sharing of the file mode

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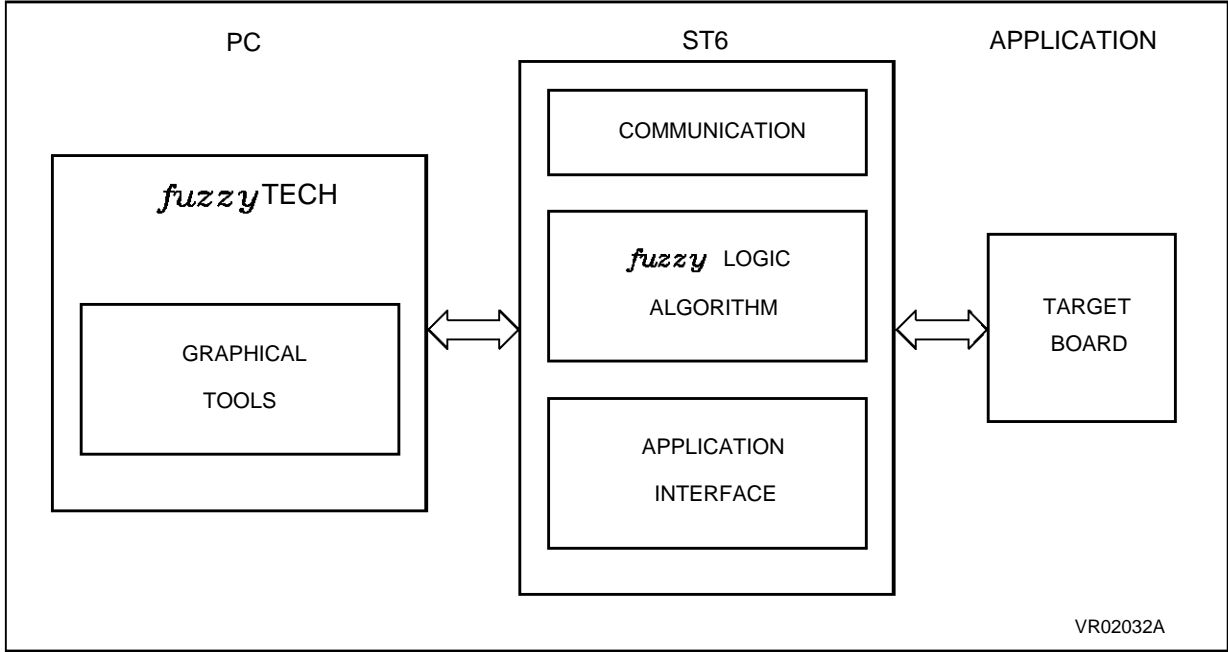
THE OPTIMISATION TOOLS (Continued)

Off-line optimisation:

The debugging tool uses files coming from the real application or from simulation. It generates files in the fuzzyTECH format which enables the use of the fuzzyTECH graphical tools to optimise the control algorithm.

- fuzzyTECH Debugger:

Test and verification of the system under design using different debug modes. The entire inference flow can be visualised, including rules and tracing variables.

- fuzzyTECH Time Response:

Rules and variable tracing either in real time, on the basis of recorded process data, or using a process simulation.

- fuzzyTECH Transfer Plot :

Visualisation with surface control of the operative rules to identify redundant rules and regions of instability.
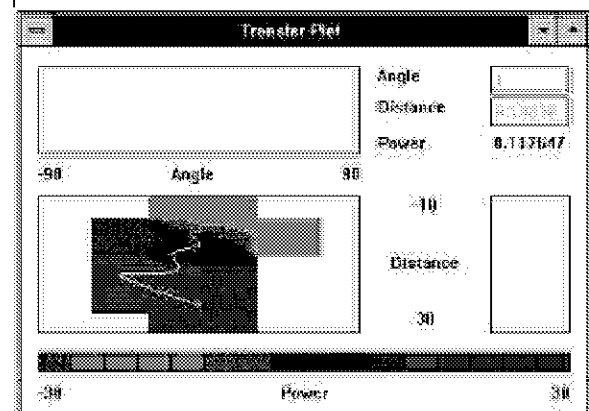
- fuzzyTECH Simulator:

To get started right away, an animated simulator of a crane container control is provided. By experimenting how modifications on rules affect the crane performance, the basics of fuzzy logic control can be understood.

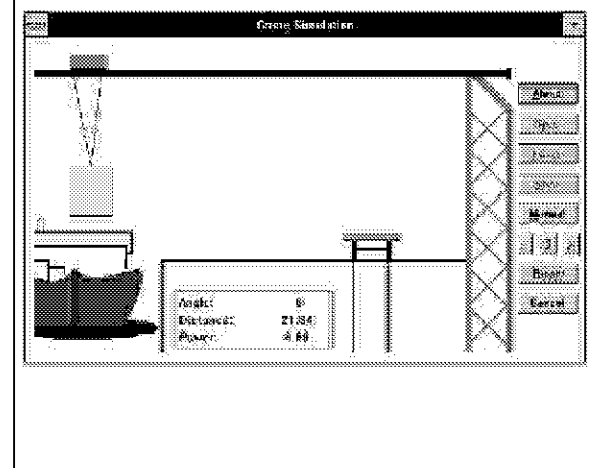**Figure 5. Optimisation Screen Examples**

Example of Time Response
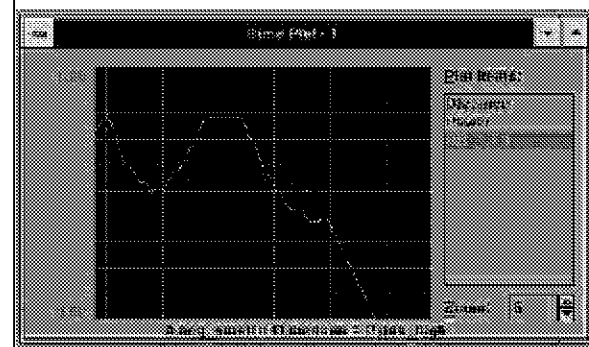
Example of Transfer Plot

Example of Simulator

CODE GENERATOR:

fuzzyTECH is a hardware independent object oriented program dedicated to fuzzy logic. Its output has to be compiled and linked to the rest of the application prior to use in the target microcontroller.

The ST6 code generator is used to produce highly optimised ST6 assembler code which minimises the program size. Data acquisition and data out is made using the conventional peripherals and programming resources of the microcontroller.

The fuzzy logic code is merged with the conventional program using the "link" procedure of the current ST6 programming software. The linked code is loaded into the ST6 EPROM or OTP part using an ST6 programming tool for full product evaluation, test and production.

TYPICAL PROGRAM FLOW CHART

The fuzzyTECH ST6 Explorer Edition blocks are called as subroutines of the ST6 application program. A typical flow chart is given here below:

Figure 6. Typical Flow Chart
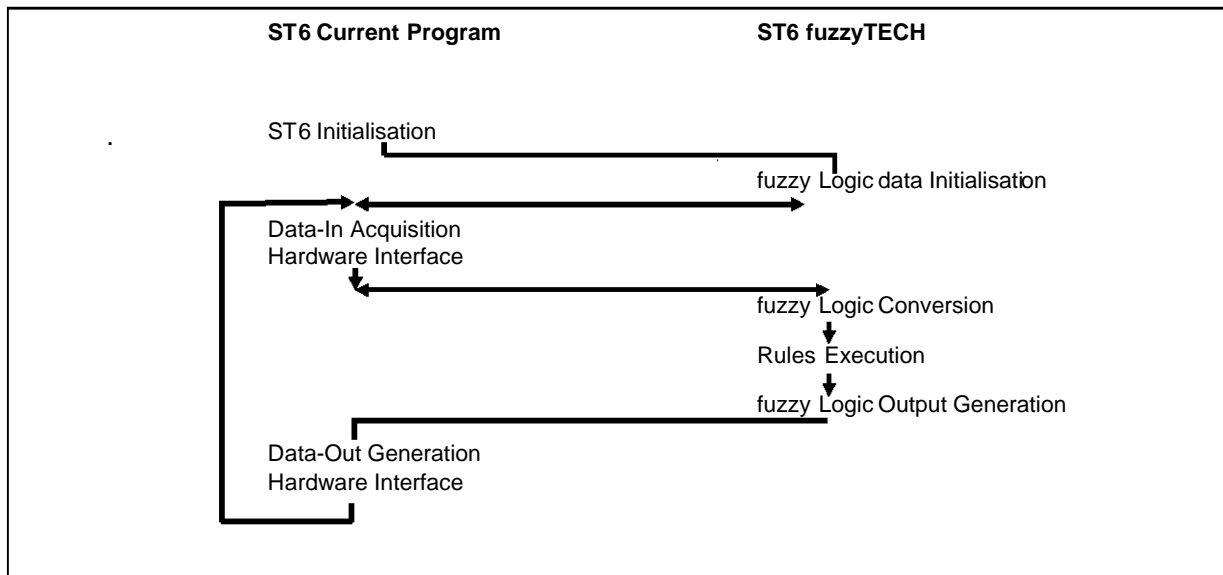
APPLICATIONS

Fuzzy logic brings computer reasoning closer to the way people think. It suits well applications that are more easy to describe with a linguistic approach than with a mathematical model, especially non-linear systems. It provides also a bridge between the analog and digital world, enabling a designer with a good analog background to develop a microcontroller based control without digital expertise.

fuzzyTECH ST6 Explorer Edition is particularly useful in applications which can be defined with few inputs and one output and where a resolution of 8 bits and a dynamic range of around 100ms are sufficient to control the system.

Typical applications are home appliances (washing machine, vacuum cleaner and food processor,...) , temperature control (air conditioning, refrigeration, cooker, oven, central heating, furnace,...), sensor interfaces (InfraRed detector, Alarm, ...), motor control (speed or position), or battery chargers. Being user-friendly, fuzzyTECH enables a system expert without microcontroller knowledge to define the control in a short time.

APPLICATION NOTES

Several application notes describe practical systems designed with the fuzzyTECH ST6 Explorer Edition. They show how to take advantage of its friendly user interface and debugging facilities to design an optimised control, even for relatively fast "real time" loops, without specific experience on digital control techniques. These notes are enclosed in the fuzzyTECH ST6 EXPLORER EDITION documentation.

HARDWARE/SOFTWARE REQUIREMENTS

- A 80386 (or higher) PC with at least 2Mbyte of memory
- MS-Windows 3.1™ or higher and MS-DOS 5.0 or higher
- Hard disk with 5 Mbyte of free space and a 3.5" floppy disk
- VGA monitor supported by Windows

The generated ST6 assembly code runs on every member of the ST6 microcontroller family. For the implementation, ST6 assembler/linker software and a programmer socket are required.

Each fuzzyTECH ST6 Explorer Edition set includes a 3.5" floppy disk and two books, one user manual with application notes and one detailed datasheet.

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NOTES :

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