# Deeds Digital Electronics Education and Design Suite

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"The Deeds of Gallant Knights" This image from a picture of G. David, XVI Century Paris, Musèe de l'Armèe

#### Deeds is the acronym of Digital Electronics Education and Design Suite...

but, as "*deeds*" mean, we are not sure if they will be good or bad...

Just like *The Deeds of Gallant Knights* that the splash form recalls...





# What is **Deeds**?

 Deeds is a set of educational tools for Digital Electronics, characterised by a "learn-by-doing" approach.

#### Deeds covers the following areas:

- combinational and sequential logic
- finite state machine
- microcomputers



#### What **Deeds** includes? (1)

- Assistant Browser, to navigate among lessons, exercises and laboratory assignements
- A Digital Circuit schematic Editor
- An interactive Circuit Animator
- An interactive Logic Simulator





# What **Deeds** includes? (2)

- A Finite State Machine designer
- A Microcomputer Board Emulator
- A microcomputer Assembler
- An Interactive Debugger
- A User Management data-base tool



#### Interaction among the tools

- The Assistant Browser can launch all the other tools
- It interacts with editors and simulators, providing a true interaction between text and experiments
- Simulators interact with each other



#### The integrated simulation

 The schematic editor allows to merge standard logic circuits with one or more Finite State Machines and an Emulated Microcomputer Board

 It is possible to experiment with digital systems controlled by state machines and microcomputers, port interfacing and lowlevel programming of embedded systems



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# **Deeds** as Learning Environment

- A collection of tools and text material that help students acquiring:
  - Theoretical foundations of the subject
  - Analysis capabilities
  - Ability to solve problems
  - Practical synthesis and design skills





#### Deeds as a common resource

- **Deeds** is a set of tools that teachers can complete with their own materials to suit their pedagogical needs
- There is no need for a specific authoring tool, because the "lecture space" can be composed with any HTML editor





# **Deeds** to teach theory

- A lecture based on **Deeds** appears as HTML pages with text and figures
- It looks like a normal document, but many of the figures and visual objects are "Active", because they are connected to the editing and simulation tools



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#### **Deeds** to solve exercises

- Exercise assignments are presented as HTML pages with text and figures
- The role of **Deeds** is:
  - To check the correctness of solutions obtained manually
  - To provide graphical tools for editing the web page containing their reports
  - To deliver the reports through the network



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#### A new approach to exercises

- With the availability of simulators, students may be tempted to skip manual analysis
- **Deeds** suggests a different approach to the exercise structure
- Exercises can be targeted more to the real understanding of the issues than to the execution of repetitive tasks





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#### **Deeds** to learn to design

- The development of a digital design project is the field where **Deeds** can fully be exploited
- Deeds allows the simulation of today's systems, where standard digital components can be controlled by state machines and/or a microcomputer board



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# **Deeds** for NBPL project work

- Students use **Deeds** to download the assignment from a web page
- Project development phases are guided by help and instructions supplied through the Assistant Browser



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#### **Deeds** for practical design

 In the following, we provide a glimpse on how **Deeds** tools can be used for a project, combining different techniques of digital design



#### **Deeds** - The Assistant Browser

- The Assistant Browser is opened, showing a page with a project assignment
- All objects in the page can be Active. By clicking on the schematics, the circuit will be loaded in the Digital Circuit Simulator, ready to be tested

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In this first phase of your project you are given the schematics of a digital network. You do not know the functions nor the time behaviour. Your first assignment is to analyse the network, first manually and successively with the help od the Digital Circuit Simulator. Your first deliverable (with this term we mean the product that you must deliver to us to get credit) is a document with the two timing diagrams obtained as described above, integrated by a short textual description highlighting what you found.

#### **Deeds** - The Digital Circuit Simulator

- The basic operations of professional tools have been adapted to the educational needs
- The components available on the bin are simple to understand
- We avoided complex real components, that could confuse the beginner

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# **Deeds -** The Timing Simulator



**Timing simulation** can be executed in a functional mode (with no time delays) or in truetime mode Simulation can be interactive, with a step-by-step approach, or can be launched defining a time interval, as in professional tools

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# **Deeds -** The FSM Editor

- Finite State Machines

   (FSM) can be designed in various languages (HDL, State transition table, ASM chart), and using specific graphical editors
- Finite State Machines can be tested before synthesis
- Finite State Machines can be stored as components and inserted in the digital schematic editor





### **Deeds** - The µC Board Emulator (1)

- The Microcomputer Board Emulator includes an 8-bit microprocessor, a RAM and ROM memory system and a simplified parallel I/O ports
- The 8-bit microprocessor is a revised and simplified version of the well-known Z80-CPU



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#### **Deeds** - The µC Board Emulator (2)

- The Microcomputer Board Emulator allows to edit assembly code with syntax highlighting
- Assembly code can be partitioned in multi-file projects
- The two-pass assembler is transparent to the user

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### **Deeds** - The µC Board Emulator (3)

- The Microcomputer Board Emulator allows to debug the assembly code at memory and register level with an interactive visual debugger
- The debugger allows a full control of the microcomputer operations, including I/O operations

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