Design technology / Computer science

In 2014 we are focussing on products for use in schools between the ages of 14 and 16 and you can see these products on the following pages.
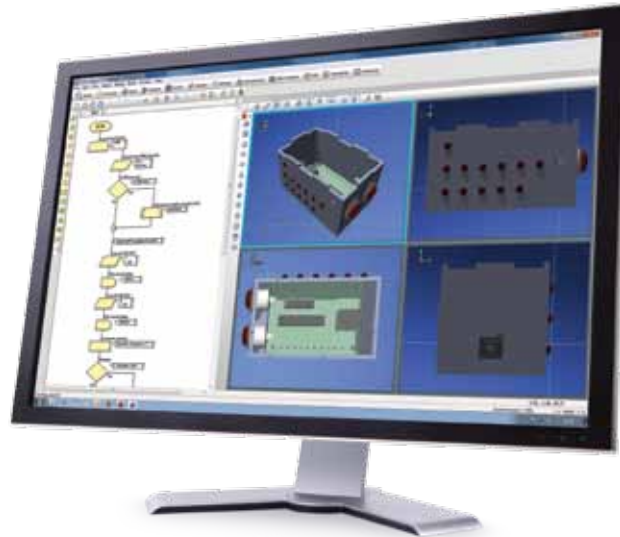
Contents

Students at St Joseph's Institute, Schoten, Belgium, solving a simple maze using the Formula Flowcode robot and Flowcode.

MATRIX

"Released March 2014"

6

Import mechanics from Solidworks, and design and simulate the electromechanical system in Flowcode

Flowcode Schools Edition (SE) is a function limited version of Flowcode 6 which allows students to develop programs for microcontrollers and Windows compatible PCs. Flowcode SE provides a great platform for learning about electronics, informatics/computer science and mechanics in a single package.

Design Technology (D&T) students can use Flowcode to learn about programming, circuit and product development based on selected PIC, AVR, and Arduino microcontrollers and on a Windows PC. D&T students can simulate their microcontroller based designs, and can also see how electromechanical systems are controlled by computers.

Computer Science students can use Flowcode SE at various levels: starting with simple program construction using Flowcharts, working up to complex programs with subroutines, interrupts, complex data structures and external files. Computer Science students can use Flowcode at a systems level to develop sophisticated programs that interface to simulations, to hardware systems and to networked computers and devices.

Students can use Flowcode for learning programming, electronic design, robotics, and pneumatics and can link programs for a range of Matrix hardware systems including our low cost Prototype and projects boards, Formula Flowcode robot, our MIAC and Automatics solutions and any third party hardware that accepts hex code for the appropriate microcontroller devices.

- A function limited version of Flowcode 6
- Develops code for microcontrollers and Windows PCs
- Supports selected PIC, AVR, Arduino, dsPIC microcontrollers
- Compatible with many third party microcontroller development systems
- Links to Solidworks and other 3D design packages
- Interfaces to the internet, and many other computer systems
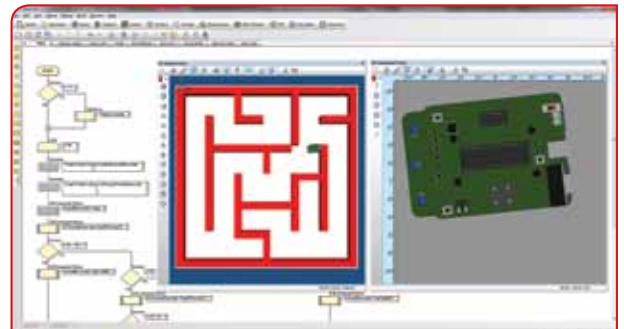
Solve robot mazes in a virtual environment….

…and test the programs in the real world.
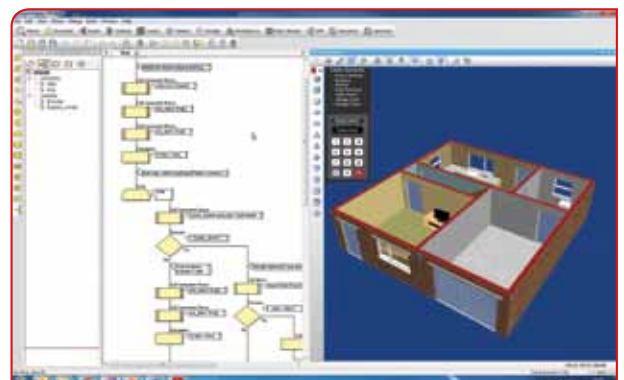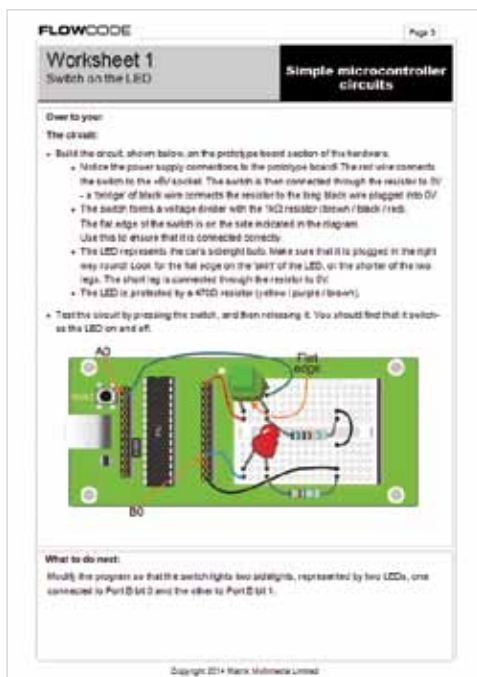
Control our virtual house in Flowcode

Ordering information	
Flowcode SE single user	FC6SE1
Flowcode SE site licence	FC6SE50

Curriculum packs

Use of Flowcode and associated hardware is well supported in the classroom by a number of curriculum packs - all of which are free of charge and downloadable. Curriculum packs include clear instructions for students to follow to achieve the desired learning outcomes. Support for teachers is also included in the form of hints and tips in delivering learning in the classroom.

Introduction to microcontroller programming course

This free online resource provides a complete course in developing microcontroller based systems using Flowcode. The course contains a suite of 13 labs each of which has an accompanying Word worksheet. Students print a worksheet and then work through the contents of the CD ROM, developing systems using Flowcode to complete each lab. Each worksheet has a number of tasks, graded to cater for mixed ability classes. Supervisors can use the accompanying Excel marking scheme to track the progress of students as they work through the material. The course is based on E-blocks but is usable on other hardware platforms.
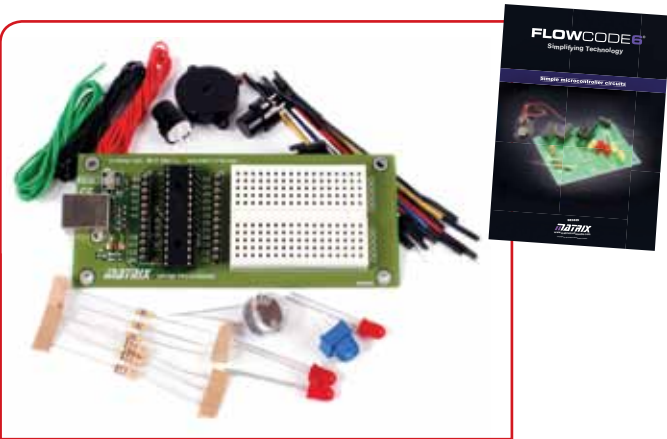
Learning objectives /experiments

- Microcontroller programming and circuits, clocks, pins, inputs, outputs, ports, memory and memory types, current limits
- Programming using flowcharts: input, system, output, loops, decision, subroutine, go to, calculations, delays, variables, strings, A/D conversion, interrupts, hardware macros, software macros, arrays
- Techniques: Binary, Hexadecimal, ASCII, calculations
- Components: clocking devices, switches, LEDs, LED arrays, sensors, buzzers, keypad, LCD, 7-segment displays, quad 7-segment displays, power supply, EEPROM
- Techniques: switch debounce, Schmitt trigger, prototyping with E-blocks strip board, PCBs and proto boards, using batteries

Ordering information	
Simple microcontroller circuits	SE3829
Design and make electronic products	SE4855
Introduction to microcontroller programming course	ELFCS2
Introduction to robotics	SE8832
Computer science and control 1	SE7761
Computer science and control 2	SE5690

Available free online

Ordering information	
Introduction to microcontroller programming	ELFCS2

MATRIX

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Simple microcontroller circuits

This solution introduces students to the basic principles of circuit construction and prototyping using a breadboard and a few simple electronic components. The manual includes 10 simple microcontroller circuits along with guides to developing the associated control programs using Flowcode. This low cost solution is an ideal starting point for students of Design and Technology who want to understand how to incorporate microcontrollers into their projects. Needs Flowcode SE software. Requires USB cable.

Learning objectives /experiments
- Microcontroller programming and circuits
- Microcontroller clocks, pins, inputs, outputs, ports,
- Programming using flowcharts: input, system, output, loops, decision, subroutine, go to, calculations, delays, simple variables, A/D conversion, pulse and tone generation
- Components: switches, LEDs, sensors, buzzers, resistors, potential dividers.
- Logic: AND, OR, NAND, NOR, NOT

Prototype board in use

Components included			
1	Buzzer	1	Light dependant resistor
3	470R resistors	3	LEDs (red, green, orange)
1	1K resistor	3	Push to make switches
1	4k7 trimmer	1	Lengths single core wire
1	USB prototype board	1	Pack connector leads

| Ordering information	
Simple microcontroller circuits solution	SE3829
Class set of 20	SE4758
Curriculum pack	SE3829

You may also need:	
USB cable	HPUSB

Design and make electronic products solution

This solution is designed to provide a framework to allow students to first investigate the design of electronic products and then to design and manufacture a project of their own. The curriculum first guides students through a number of pre-built designs based on our PIC project board and pre-designed Solidworks projects. Students then undertake a design brief to develop an electromechanical project of their own. Needs Flowcode SE software. Requires USB cable.

Learning objectives /experiments
- Controlling DC motors, servo motors, stepper motors, solenoids, and pneumatic systems
- Investigating electro mechanical designs
- Packaging and packaging design for electronic products using Solidworks® CAD
- Designing, making and testing electronic products using Flowcode
- Designing, making, testing and evaluating mechanical products using laser cutters, 3D printers and other CAD/CAM resources
- Writing up projects
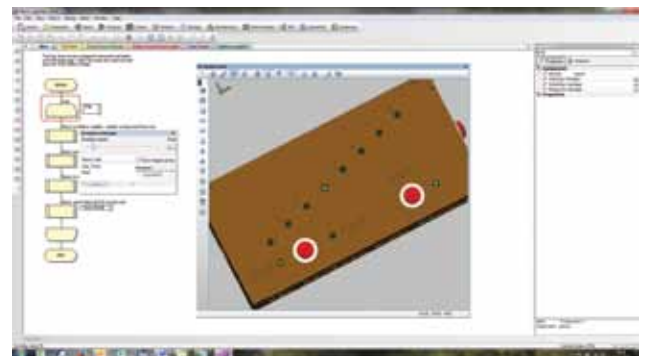
Egg timer project with mechanics created in Solidworks

Components included			
1	Relay	3	MES lamp holder
1	DC motor	1	Red MES LED bulb
1	Stepper motor	1	Yellow MES LED bulb
1	Servo motor	1	White MES LED bulb
1	Reed switch	1	Solenoid
1	Toggle switches	1	Isonic pneumatic valve
1	USB project board		

Ordering information	
Design and make electronics products pack	SE4855
Class set of 20	SE9885
Curriculum pack	SE3844

You may also need:	
USB cable	HPUSB

NEW

Computer science and control 1

This kit of parts allows Computer Science students to develop an understanding of simple control systems and to develop programs using flow charts. The kit uses our MIAC controller as a PC slave and as an embedded microcontroller target. The kit includes switches, bulbs, motors and sensors which plug into the MIAC using 4mm connectors to allow students to cement their understanding of control using real physical parts. Requires Flowcode SE software.

Learning objectives /experiments
- Microcontroller based systems
- Control system theory of simple systems: Input, system, output, open loop, closed loop
- Programming using flowcharts: input, system, output, loops, decision, subroutine, go to, calculations, delays, variables, strings, A/D conversion, interrupts, hardware macros, software macros, arrays.
- Control components: switch, light sensor, bulbs, motors
- Industrial controllers, Microcontroller based systems.

See MIAC section for full MIAC details

Components included			
1	Cased MIAC	2	MES LED bulbs
1	Power supply	1	4mm Light sensor
1	USB lead	2	4mm to 4mm lead, black
2	4mm Push to make switches	2	4mm to 4mm lead, red
1	4mm DC motor	2	4mm MES bulb holders

Ordering information	
Computer science and control 1	SE4829
Curriculum pack	SE7761

NEW

Computer science and control 2

This pack of Flowcode simulations allows Computer Science students to develop more complex control projects using Flowcode. The pack covers the development of five projects: The first three projects are fully functional electronic products which include electronics and 'physical' packaging developed in Solidworks. Students are given all the elements of the design which they then need to bring together and program. These three projects, based on our USB Project board, can be built if needed. The two larger projects are based on 3D systems modelled within Flowcode. Students must use the 'Physical' model and develop programs to make the system function as required.

Learning objectives /experiments
- Advanced programming with extensive use of macros and functions with parameters
- Development of complete electronics products in a virtual world
- Advanced egg timer
- Binary clock
- Modelling of virtual systems using software
- Windmill
- House

Ordering information	
Computer science and control 2 curriculum pack	SE5690

6

The Automatics essentials solution

This kit provides a complete introduction to pneumatic circuit design and construction. The included curriculum pack includes a comprehensive set of worksheets that allow students to progress from first principles through to circuits of moderate complexity; including reciprocating circuits and generating sequences of movements.

The solution is intended for students in their early teens and older who are learning technology and engineering subjects. Tasks are designed to be suitable for pairs of students sharing a single kit. Everything you will need to teach the course is included in the solution pack, with the exception of an air compressor.

Learning objectives
- Understanding the different varieties of valves, and where each is appropriate in a system
- Understanding the basic types of cylinder, controlling speed, and the factors that influence power output
- Combining valves to produce logic functions
- Semi-automatic and automatic reciprocation
- Creating sequences of movements
- Using reservoirs to create time delays
- Air bleed and pilot operated circuits
- Component symbols and circuit diagrams
- Staying safe when using air at high pressure

Pneumatics control add-on kit

This kit extends your Automatics pneumatics solution by adding a powerful programmable microcontroller unit, the MIAC, together with the pneumatic components necessary to put it through its paces.

By following the included curriculum, students will learn how the combination of a controller and custom software can create powerful and flexible pneumatic systems.

Students will learn how to establish the state of a pneumatic machine using sensors, the use of logic to process that data, and the issuing of commands to the included solenoid valves.

Two versions of the curriculum are supplied. In the first, students use pre-programmed control systems supplied in the MIAC's built in memory. A more advanced course, Control plus, teaches students how to write their own programs for the controller.

Learning objectives
- Reading sensors and switches
- Issuing commands to the pneumatic circuits
- Learning the difference between digital and analogue signals
- Using flowcharts to visualise programs
- Program flow and decision making
- Programming sequences
- Using feedback to enhance reliability and improve safety

Control Plus

This curriculum introduces students to writing their own programs for the control system.

This is done using our Flowcode software - which makes programming easy by using graphical flowcharts. Note that you may need to purchase Flowcode separately.

AW4955

Components included			
1	Cylinder, single acting	2	Cylinder, double acting
1	Valve, 3/2, button-spring	1	Valve, 3/2, lever-spring
4	Valve, 3/2, roller-spring	1	Valve, 3/2, diaphragm
1	Valve, 5/2, lever-spring	3	Valve, 5/2, pilot-pilot
1	Valve, shuttle	2	Valve, flow control
1	Reservoir	1	Automatics platform
1	Manifold	1	Tubing, red, 5 m
1	Tubing, yellow, 30 m	1	Tubing, blue, 30 m
4	Connector, tee junction	1	Tee bolts (pack of 50)
1	Tube cutting tool	1	Curriculum CD ROM
1	Set of storage trays		

Ordering information	
Automatics essentials solution	AW20801

You may also need...	
Compressor	AW30100

Components included			
1	MIAC controller	2	Switch, push to make
1	Reed switch and holder	2	Valve, flow control
1	Light sensor	4	Valve, 3/2, solenoid-spring
1	Power supply	1	Power distribution carrier
6	Lead, 4mm plugs, red	6	Lead, 4mm plugs, black
2	Lead, 4mm plugs, yellow	1	Curriculum CD ROM

Ordering information	
Automatics control add-on kit	AW4955

| You may also need...	
Automatics essentials solution	AW20801
Flowcode	See page 70

PICmicro microcontroller systems investigation

This new kit allows students to investigate circuits and systems based on the popular PICmicro microcontroller. The kit focuses on system construction with a pre-programmed PIC carrier which includes 8 programs, selectable by hardware switches. The work can be extended to include programming of PICmicro® microcontrollers using flowcharts with our Flowcode software. A full curriculum pack is included.

Learning objectives /experiments

- Switch inputs
- Sensors and sensor circuits
- Digital comparators
- Driving transducers
- Output transducers
- DC motor speed control
- Open and closed loop control
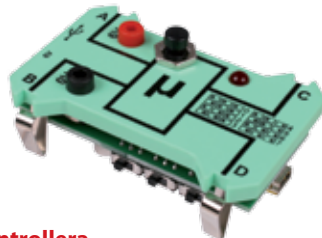
Locktronics PICmicro microcontrollera

This carrier includes a reprogrammable PICmicro microcontroller with four general purpose input output pins. When used as inputs the pins can be configured to be analogue or digital. The carrier includes three slide switches which can be used for selecting one of 8 internal programs in the PIC. The device can also be reprogrammed from the USB port. Power can be derived from the on-board 2mm connectors or from the USB port.

Components included			
1	Power supply	1	LED, yellow, 5V (SB)
1	USB reprogrammable PIC carrier with power lead	1	MES bulb, 6.5V, 0.3A
1	Light dependent resistor		Locktronics User Guide
2	Resistor, 10k, 1/4W, 5% (DIN)	1	USB2 high speed A to mini B lead
16	Connecting Link	2	Lead, yellow, 500mm, 4mm to 4mm stackable
1	Lampholder, MES	1	Thermistor, 4.7k, NTC (DIN)
2	Switch, push to make, metal strip	1	Transistor RHF, NPN
2	Switch, on/off, metal strip	1	Motor 3 to 12V DC, 0.7A
1	Buzzer, 6V, 15mA	1	Resistor, 2.2k, 1/4W, 5% (DIN)
1	Curriculum CD ROM	1	7 x 5 metric baseboard with 4mm pillars
1	Potentiometer, 10k (DIN)	1	Power supply carrier with battery symbol
2	LED, red, 5V (SB)	1	Resistor, 100 ohm, 1W, 5% (DIN)
1	LED, green, 5V (SB)	1	Resistor, 1k, 1/4W, 5% (DIN)

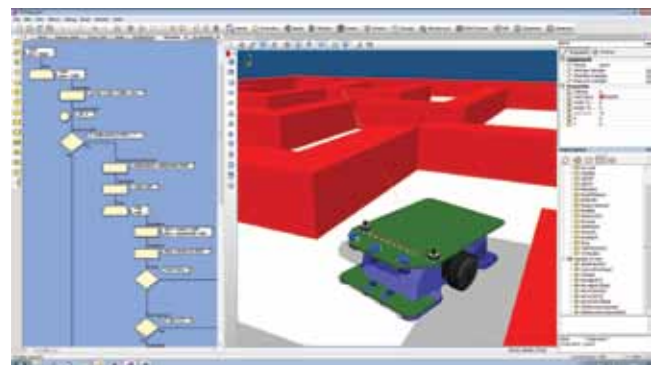| Ordering information	DIN	ANSI
PICmicro systems solution with storage tray, baseboard and power supply	LK8922	LK8922A
Corresponding curriculum	LK7209	
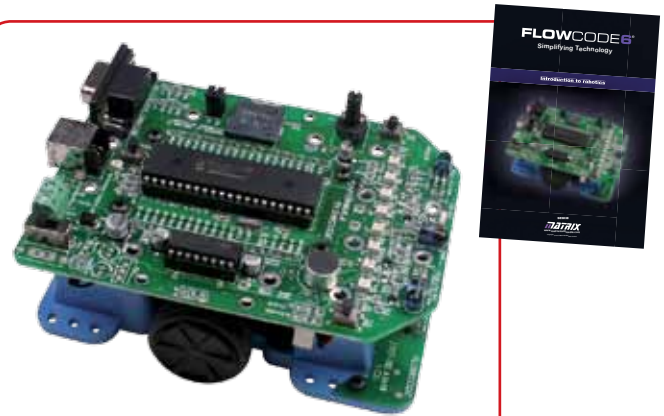
Introduction to Robotics

The Formula Flowcode robot is a high specification, low cost microcontroller-controlled robot buggy which is great for introducing students to programming and robotics in a fun and motivating way with huge scope for further work and competitions. The buggy is supplied with new simulations in Flowcode 6/SE, a beginners' course, easy to follow circuit diagrams and information, and lots of follow on exercises and expansion options (including Bluetooth, Wifi) using E-blocks.

Learning objectives /experiments

- Microcontroller programming and robotics
- Programming using flowcharts: input, system, output, loops, decision, subroutine, go to, calculations, delays, simple variables, A/D conversion
- Robotic components: switches, LEDs, light sensors, distance sensors, infrared sensors, audio level sensors, speaker, motor drivers, motors and gearboxes
- Robotic tactics including power control, motion control and steering, motor characterisation, obstacle avoidance
- Progressive exercises include: light following, line following, song and dance, time trials, races, simple maze solving, creating custom mechanics

Buggy and a line following exercise

See Formula Flowcode section for full details

Ordering information	
Formula Flowcode robot buggy	HP794
Maze walls	HP458
Starter class bundle	HP926
Pro class bundle	HP600
Curriculum pack	FF8832

USB prototype board

NEW

The Project board has been created to allow students to take designs from schematic concept to realisation very quickly. It achieves this through a small section of breadboard which allows students to create simple electronic circuits. This breadboard is simple to interface with the microcontroller through two SIL connectors providing access to all ports of the device. Breadboard also allows flexibility at a design stage with students easily able to modify designs until they have a working system. The system is powered and programmed via USB - cable not included.

Ordering information	
USB prototype board	HP4829
USB prototype board x 20	HP4820
Prototype lead pack	FLLCPK
USB lead	HPUSB

USB project board

NEW

The project board includes a USB programmable 18 pin microcontroller and a ULN2003 power output chip which give students a rugged miniature input output board that can be embedded in a wide variety of projects that include motors, lamps, and solenoids. The system can be powered from the USB lead or from batteries. The chip is based on open source Microchip code.

Ordering information	
USB project board	HP1110
USB project board x 20	HP9954
USB lead	HPUSB

6

Cased MIAC

The Cased MIAC with 4mm shrouded sockets is internally connected to all of the input outputs of the MIAC (except CAN bus terminations). This allows rapid development of circuits based on the MIAC up to mains voltages.
Power supply and USB lead included.

Ordering information	
Cased MIAC	MI0245

MIAC components with 4mm leads

This range of add -on components are fitted with 4mm connectors which plug into the MIAC to allow fast development of simple control systems

Ordering information	
Motor with 4mm leadset	SE3945
Push to make switch with 4mm leadset	SE 2995
Light dependant resistor with 4mm leadset	SE7045
MES bulb holder with 4mm leadset	SE3400
4mm to 4mm lead, black	LK5604
4mm to 4mm lead, red	LK5603
4mm to 4mm lead, blue	LK5609
4mm to 4mm lead, yellow	LK5607