MODEL 6

Automatic door

Out of the way!

KEY QUESTIONS:

- **Where are automatic doors installed in everyday life? *(Communication)***
- **What triggering options are there for operating the door? *(Communication)***
- **How can a rotational movement be converted into a linear movement? *(Creativity)***
- **Which time loops are useful when operating? *(Critical thinking, collaboration)***

THE TEACHING CONCEPT AT A GLANCE

Grade level:	6–8
Time required:	2 double lessons
Degree of difficulty:	Model
	Programming
Model type:	Table model for industrial automatic doors

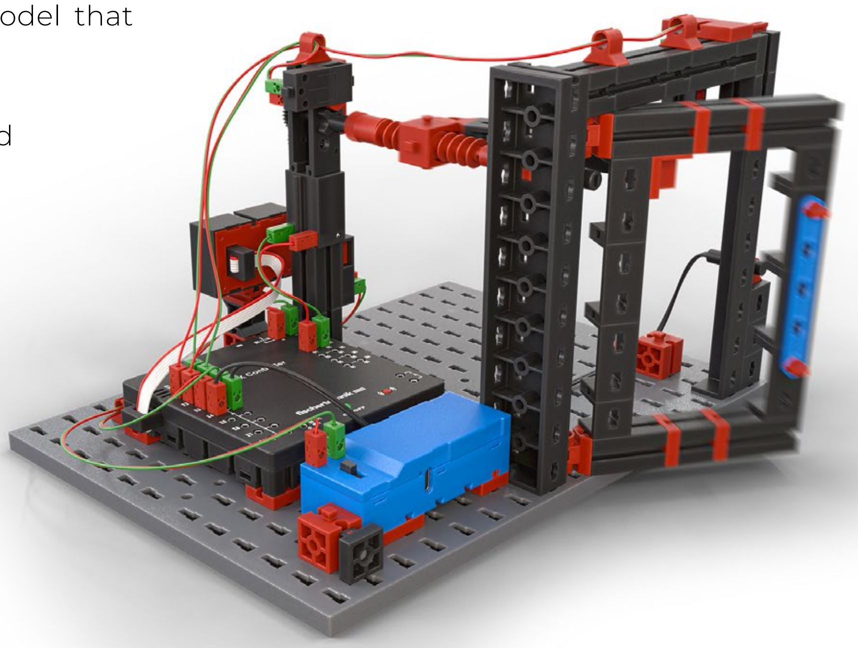
MODEL DESCRIPTION / TASK

Students plan and realize a door model that opens and closes automatically.

The automatic system can be triggered via various sensors depending on the differentiation requirements:

- Manual switch (basic circuit),
- Magnetic access card (differentiation 1) or
- Motion detection (differentiation 2).

The closing time can be set variably via the programming.



EVERYDAY RELEVANCE

The function of an automatically triggered mechanical movement initiated by a sensor is becoming increasingly present in the everyday lives of students (car doors, tailgates in vehicles, elevator doors, automatic faucet ...).

Triggering an automated function (e.g. through switches, changes in brightness, movement or gesture control) has always been highly motivating, as well as the combination of mechanical movements with modern controls.

Preprofessional orientation also plays an important role with regard to using, understanding, developing, and optimizing a corresponding system.

SUBJECT REFERENCE

- **Information technology:** Programming basics of various sensors, time loops
- **Physics:** Mechanical and kinematic aspects of movements
- **Technology:** Gear theory, manufacture and optimize an object

LESSON PLAN

Introductory phase		
Classroom discussion		• Inquire about scenarios in which automatically triggered mechanical processes make life easier. • Collect different possible systems from the everyday lives of students. • Presentation of the task. • Discussion of possible sensors and definition of the solution(s) to be implemented. • Discussion of reasonable time intervals (delays) and definition of time loops. • Discussion about the realization of possible kinematic solutions (rotation/translation) and determination of the kinematic realizations of the drive.
Support, if necessary		• Show sensors, actuators and components from the assembly kit, use presentation media if necessary.
Planning Phase		
Classroom discussion		• The teacher specifies the procedure using the work steps in the app.

	Partner or group work	• The students familiarize themselves with the app and download the corresponding task. • Students complete the first task in the app. • In the app, they create requirement lists for mechanical parts and sensors that are necessary for the automatic opening and closing of the door.
	Classroom discussion	• Addresses possible sensors to be used (differentiation). The minimum requirement of the task is defined: 1 sensor for opening the door. • The procedure for further differentiation is discussed.
	Optional: Partner or group work	• Students sketch the possible system and its mechanical drive. • The students discuss the results and agree on a design.
Construction Phase		
	Partner or individual work	• The students build the automatic door using the app. The app guides them through the program in short steps.
Programming Phase		
	Partner or group work	• The students write the program for the door control (button as sensor). The app guides them through the program in short steps. • The app offers assistance. • The program is transferred to the RX controller.
Experimentation and Test Phase		
	Partner or group work	• The door control unit is put into operation and tested. • Possible malfunctions in the functional sequence must be found and eliminated. The app offers assistance. • Any optimizations to the hardware and the time loop programming are carried out.
Final Phase		
	Optional: Presentation and allocation of differentia-tions	• The app offers a differentiation option for fast learners: - **Differentiation 1:** Additional control via a magnetic switch - **Differentiation 2:** Additional control through gesture control • The teacher approaches eligible students. The app realizes the further procedure..

	Discussion in plenary	• Project debriefing in class. • If necessary, the differentiation results are discussed. The use of the various other sensor controls is demonstrated. • Strengths and weaknesses of the solutions are recognized and discussed. • Outlook on optimization possibilities/needs in everyday solutions (transfer of the topic to everyday life) are identified and discussed (e.g. light barrier, warning light ...).

METHODOLOGICAL AND INSTRUCTIVE TIPS

Differentiation options
The model (basic task button on the inside) is particularly suitable for differentiation. Depending on the time available, the system can be easily supplemented with a magnetically triggered switch on the front of the door (reed switch) and/or a motion sensor (RGB gesture sensor) on the inside of the door. Programming by means of additional loops produces a great effect through further triggering options for opening the door.

Motivational Aspects
The desire to have a system that can be controlled in as many ways as possiblethrough the use of a wide variety of sensors is great. The familiarity with various everyday solutions also means that there is likely to be interest in adding further useful components to the system (e.g. visual status display of the system, warning function before the door closes, ...).

PROGRAMMING SKILLS

- Program start
- Continuous loop
- Integration of sensors
- Integration of actuators
- Loop **if – then**
- Loop **repeat until**
- Loop **wait**
- Loop **repeat – x times** (variable-dependent)
- Integration of variables
- Change of variables
- Working with subprograms

ADDITIONAL MATERIALS

Optional download:
- Circuit diagram
- Building instructions

- Optional: Drawing media (paper, whiteboard, or projection screen)

FUNCTIONS OF THE MODEL AND THEIR TECHNICAL SOLUTIONS

Function of the system	Technical solution
Triggering the door opening (seen from the inside)	Pressing a button
End position for open door	Pulse counter
End switch for closed door	Triggering the end switch (button)
Opening the door	Opening the door using a motor and worm gear
Closing the door	Closing the door using a motor and worm gear
Differentiation 1: Triggering the door opening (seen from the outside)	Triggering a reed switch using a magnet
Differentiation 2: automatic triggering of the door opening (seen from the inside)	Triggering the RGB gesture sensor

MATERIAL LIST

Sensors	Function
1 button	Triggering the door opening process
1 button	Switching off the motor when the door is closed
1 button	Defining the end position of the open door (pulse counter)
Differentiation 1: 1 reed switch	Triggering the door opening process
Differentiation 2: 1 RGB gesture sensor	Triggering the door opening process

Actuators	Function
1 motor, incl. gearbox	Opening/closing the door