

Ticket control

I need music!
Let me in!



KEY QUESTIONS:

- Where can automatic ticket inspection be used in everyday life? (*Communication*)
- What functions does the system need to fulfill? (*Collaboration*)
- Under what conditions should the system allow or deny access? (*Critical thinking*)
- What needs to be considered so that the system can be used at different locations and be as robust as possible? (*Creativity*)

THE TEACHING CONCEPT AT A GLANCE

Grade level: 7–10

Time required: 2 double lessons

Degree of difficulty: Model 

Programming 

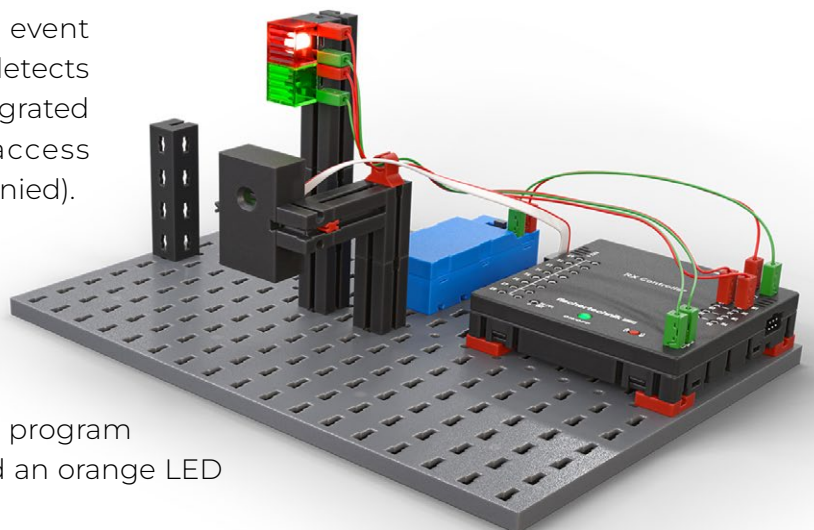
Model type: mobile device, can be positioned individually and used flexibly for ticket inspections

MODEL DESCRIPTION / TASK

Students plan and implement a ticket control system that regulates access to a music event using colored tickets. When the system detects the colors blue, yellow or green, per an integrated sensor, a green LED is switched on (access permission) or a red LED flashes (access denied).

The green LED switches off again after a preset time; then the red LED displays a continuous light.

Differentiation options: either modify the program so that only two colors allow access, or add an orange LED (ready for operation) to the model.



○ EVERYDAY RELEVANCE

The automatic triggering of a process has a strong motivational effect on students. Recording the physical quantity “color” is quick and easy for everyone to understand. Two additional options to the basic task allow the topic to be individualized.

The topic could be integrated into pre-professional orientation with regard to IT-related occupational fields. Automated switching by recording physical variables is used here in many fields. Motion detection in particular is becoming increasingly important in many areas of information technology, e.g., gesture control.

○ SUBJECT REFERENCE

- **Information technology:** Programming basics, time loops, RGB color model
- **Physics:** Light, color
- **Technology:** stable construction, construction technology, component arrangement
- **Biology:** Light colors for plant growth

○ LESSON PLAN

Introductory phase



Classroom discussion

- Announcing the topic.
- Inquire about scenarios in which automatic ticket controls are used (train stations, means of transportation, package pick-up stations, time recording, alarm system, etc.).
- Discuss possible applications of the collected scenarios
 - e.g., ticket control function: Switches on at the right color, switches off after a set time
 - e.g., train stations function: Release rotating grid with correct card
 - e.g., alarm system function: time-delayed activation to leave the house, deactivation of the alarm system with the correct card



Support, if necessary

- Show sensors, actuators and components from the assembly kit, use presentation media if necessary.

Planning Phase



Classroom discussion

- The procedure for building the model and the function to be achieved are worked out together.
- Sequence steps of the app are specified or discussed.



Partner or group work

- The students familiarize themselves with the app and download the corresponding task.
- Students evaluate various functions of an automatic ticket control system.
- They compose the list of requirements for the system to be built.



Optional:
Partner or group work

- Optionally, the students sketch the possible system.
- The students discuss the results in the group and choose a design.

Construction Phase



Partner or individual work

- The students use the app to build the ticket control. The app guides them through the program in short steps.

Programming Phase



Partner or group work

- The students write the program for the color recognition of the tickets (1 RGB gesture sensor / 2 LEDs). The app guides them through the program step by step.
- Individual intermediate steps are transmitted to the RX controller and tested.
- The app offers assistance.
- The program is transferred to the RX controller.

Experimentation and Test Phase



Partner or group work

- The ticket control system is put into operation and tested. It is only permitted to react to the color cards in front of the sensor.
- Possible malfunctions in the functional sequence must be found and eliminated. The app offers assistance.

Final Phase



Optional:
Presentation and allocation of differentiations

- Differentiation options can be discussed with the students if additional teaching time is available.



Discussion in plenary

- Project debriefing in class.
- Clarification of future application possibilities in everyday life (transfer of the topic to everyday life), recourse to the discussion in the introductory phase (e.g. train stations, means of transport, package pick-up stations, time recording, alarm system).

METHODOLOGICAL AND INSTRUCTIVE TIPS

Differentiation options

The following differentiations are possible with additional teaching time. These promote 4C skills, but are not included in the instructions of the app:

- 1) Modification of the program so that only two colors allow access. For this, the students need to independently reorganize the existing program, developed in short steps, in a relatively more demanding approach. They can also decide which colors allow and block access.
- 2) Extension of the model with an additional LED. In this extension, the students should independently integrate an additional LED and modify the programming so that the orange LED indicates operational readiness, the green LED lights up when access is granted, and the red LED lights up when access is denied.

Motivational Aspects

All students are familiar with the topic of ticket control and corresponding applications from everyday life.



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
- Handling lists

Optional download:

- Circuit diagram
- Building instructions

ADDITIONAL MATERIALS

- If available, pictures of ticketinspection machines can be presented for the introduction to the topic.
- Drawing media (paper, whiteboard, or projection screen).

FUNCTIONS OF THE MODEL AND THEIR TECHNICAL SOLUTIONS

Function of the sensors/actuators	Technical solution
Recording a color	Evaluating the signals on the gesture sensor
Light output	Green and red LEDs light up
Differentiation 1	Reprogramming the system
Differentiation 2: additional display	Installation and configuration of an additional LED

MATERIAL LIST

Sensors	Function
1 RGB gesture sensor	<ol style="list-style-type: none"> 1. Color recognition of blue, yellow, green, red 2. Triggering the switching operation
1 button	End switch for gear motor 1
1 button	End switch for gear motor 2
1 reed switch	Signal for gear motor 2

Actuators	Function
1 LED, green	Display for access allowed
1 LED, red	<ol style="list-style-type: none"> 1. Ready for operation (continuous light) 2. Display for access denied (flashing)
Differentiation 2: 1 LED, orange	Operational readiness