

Internet of Things – The Intelligent LED-Sign

The realisation of an LED-sign introduces to the world of the Internet of Things, one basic technology of Industry 4.0. Within this project students with focus on electronics or software development may learn how to plan, use and program basic microcontroller hardware which may be controlled by web or mobile. The student module is divided in 4 submodules:

Basics of programming, Basics of electronics, Basics of microcontroller programming, Using MQTT for connection to the Cloud.

Sequences

Scenario means a narrative scenario which is presented in an authentic situation.

Tasks means the development of the concrete tasks, the work plan, (international) division of work, ways of collaboration.

Problem solving means a multidisciplinary or multinational problem solving, implementation of the tasks.

Assessment means an assessment of training success.

Reflection and evaluation means a meta-cognitive self-reflection and evaluation of the learning process.



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Content / Material

Scenario

The company you work for needs to improve its advertising. Therefore, the design of an LED sign must be developed. The LED sign should be controlled by a mobile phone and it should be possible to detect the ambient brightness and the presence of people in order to adapt the behaviour of the advertisement.

The customers want an own creative implementation. They imagine a LED sign, similar to the one shown in the illustration. The LEDs should be animated. This means that by cleverly switching LEDs on and off, interesting representations are to be created.

To obtain information about the customer's presence, current status messages are to be transmitted to the Internet. It should also be possible to control the advertising completely via the Internet.

Resources: [Examples of LED Signs](#)

Tasks

In order to get an idea of the planned design and the functionality of the illuminated advertising, the customer first wants you to create a simulation. The luminous advertising shall only be produced after the customer has accepted the simulation.

To become familiar with the production of a neon sign, you should first develop your personal own design.

To realize the implementation of the project some challenges have to be overcome.

The basics of programming have to be mastered, the functionality of microcontroller hardware has to be understood, practical skills in handling tools have to be learned and finally common concepts of cloud communication have to be applied.



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Problem solving

1. Creation of a virtual neon sign

First create a virtual version of your idea of the neon sign to show the design and the functional behaviour to the customer. A wide variety of approaches are conceivable for the creation of virtual neon signs.

During the development of the simulation, the limits of the hardware that can be used later must be considered. In addition, size specifications of the customer must be taken into account.

Resources:

- Using of the programming environment Processing to realize a [simulation](#)
- [Task1_SimulationCode.zip](#)
- A more general introduction to programming in [“Processing”](#)

2. Practical construction

As a result of simulation you should be able to physically build the LED.

It is helpful to use the virtual solution to generate help for manufacturing. For example, a drilling template can be created. You have to realize the electrical interconnection with the control hardware.

Resources:

- [Step2_PracticalConstruction.pdf](#)
- [Task2_Layout LED-Sign-WEMOS-double-layer.zip](#)
- [Step2_Layout LED-Sign-WEMOS-single-layer.zip](#)

3. Programming control

The use of a microcontroller is suitable for completely implementing the simulated behaviour in practice. One possible implementation is shown here.

Resources:

- Implementation of the control using the WEMOS D1 Mini
- [Step3_ProgrammingControl.pdf](#)
- [Task3_WEMOSCode.zip](#)



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4. Neon sign 4.0

After programming the control logic using a microcontroller you can move to put des LED-sign into the Internet by implementing internet communication using a WIFI-enabled device

Resources:

- Implementation of the MQTT connection using the WEMOS D1 Mini
- [Step4_LED4Zero.pdf](#)
- [Task4 - An introduction to the Internet Of Things.pdf](#)

Assessment

Verify that the way in which the project was carried out met the client's requirements. In particular, customers want simulation and realization to show the same results. In addition, it goes without saying that the desired requirements have been implemented.

Several assessments will be carried out during the project. In addition to presenting the results, you must demonstrate that you have understood the content, for example by making changes immediately. In particular, the following aspects may be assessed.

1. First the idea of the LED-sign has to be presented. The design proposal must comply with the specifications. The animation must attract attention. You have to be able to change the customer's wishes by adapting the virtual neon sign.
2. The practical implementation must be presented. Changes to the animation must be justified in simulation and real life.
3. The cloud communication must meet the requirements. Changes in MQTT communication must be carried out.

Reflection and evaluation

Planning procedures are particularly important for projects of this complexity. In particular the complete thinking through of a solution before start of the actual realization is of enormous importance.

Evaluate this aspect in addition to the increase in professional learning in the area of IoT through project implementation with the help of the [evaluation sheet](#).



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How to use it

Scenario

Show a prototype of a neon sign or draw attention to well-known signs in the cityscape.

Tasks

Present the customer requirements. The requirements can be specified by the teacher or another customer, or the requirements for the neon sign are developed in the class discussion. The necessary work steps may be worked out together.

Problem solving

In order to master the challenges, guided course phases, lectures or small intermediate projects can be incorporated.

1. Creation of a virtual neon sign

Use any programming environment or alternative application to create a simulation of the illuminated advertising that looks as real as possible. All students can simulate the same design or develop individual representations.

Finally, a drilling template is to be created from the virtual illuminated advertising version.

The implementation example with the programming environment "Processing" shows a possible variant.

2. Practical construction

It should be possible to generate a drilling template from the simulation results. With this template holes for the desired LEDs can be drilled on thin wood panels (e.g. 3.2mm hardboard) with the suitable tool.

The LEDs are then soldered together in groups with suitable resistors.



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3. Programming control

In principle, any standard microcontroller platform is suitable for controlling illuminated advertising. The challenge in this implementation, however, is the very high power consumption of the neon sign, which requires special precautions.

In this example, a platform based on the WEMOS D1 mini was developed to enable the desired integration into the cloud via a WIFI connection without any problems.

4. Neon sign 4.0

In order to control the luminous advertising as a real IoT device via the Internet or to query data of the advertising, various methods can be used. A quite common and established variant works with the MQTT protocol. The implementation of this version is shown in the following resources.

Assessment

Depending on your preferences and teaching methods, parts of the student's performance can be reviewed in the form of class tests or technical discussions. But also in the production of documentations (video, text) or blog articles.

Reflection and evaluation

The final aim was to check whether the desired results had been achieved.

This can be done, for example, in the form of a short self-reflection survey.



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