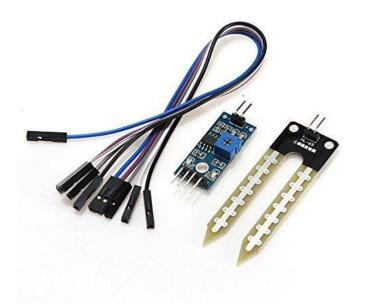


Raspberry Pi Components

-Prof. Chandrakant Borle

Moisture Sensor



This analogue humidity sensor finds an excellent place in automatic irrigation systems. It is placed in the ground and measures the humidity by current flowing between the strands. The more humid the earth in between, the higher the (analog) signal. In order to read the value with the Raspberry Pi, the MCP3008is needed (Arduinos can recognize analog signals directly).

MQ-2 Gas Sensor



The MQ gas sensors can detect different gases at room temperature.

Depending on the model, other gases are supported. The MQ-2 can recognize methane, butane, LPG and smoke, the MQ3 detects, for example, alcohol, ethanol and smoke, etc. You can find a list of all MQ sensors and their supported gases here.

You should take care that these sensors can be very hot and they should not be touched directly. Since these modules also work analogically with 5V, you need also a MCP3008 as well as a 3.3V-5V TTL to read the signals.

PIR Motion Sensor



The PIR motion sensor has some advantages over other similar products: besides the low price, a signal is sent only if something moves. This allows you to wait for signal flanks using the GPIOs. In addition, a resistance can be varied so that a signal is only sent when the movement is close, or changes that are already far away are perceived.

HC-SR04 ultrasonic sensor



The HC-SR04 sensor is not a distance / motion detector, but an ultrasonic sensor. Through a small trick it is nevertheless possible to measure distances. By measuring the time elapsed between transmitting and receiving an ultrasound signal, you can derive the distance as the sound velocity in the air is known. In the tutorial I explain the details. The wide opening angle is an aspect which, however, must be considered: since the ultrasound propagates not only on a straight line, but at an angle of about 15°, the signal is first reflected from the nearest point in this area – which can be also an external point.

RFID-RC522 - Inductive RFID card reader



The RFID-RC522 is a card reader for check cards. A signal is transmitted via the SPI data bus as soon as a card approaches on a few centimeters. Each card has a different code, which you can read out. Thus, for example, locks and / or doors could be realized, which open without contact — sesame open up

GPS NEO-6M Module



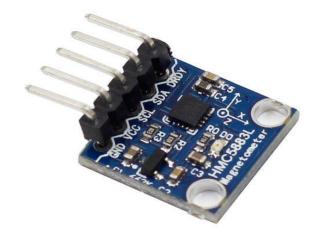
The most common and best known GPS receiver is the NEO-6M module. All GPS position data can be determined with the help of the orbiting satellites. In addition, it is compatible with the Raspberry Pi packages minicom and gpsd, which makes reading the coordinates very easy.

MPU-6050 Gyroscope



A gyroscope (circular instrument) is used to detect the rotation along the three axes. The MPU 6050 sensor also contains an acceleration sensor. This module can be used e.g. in robot arms to determine the angle of rotation.

HMC5883L / GY-271 Compass



As with analogue compasses, the directional display can also be read digitally. The HMC5883L sensor, which is read out via I2C, which returns an angle in radians, is suitable for this purpose. As with a normal compass, the value can be confounded by metal objects nearby

DS1307 RTC



If the Raspberry Pi is connected to the Internet, it can request the exact time. This could be a problem in applications where no (permanent) Internet connection is given, but the date and the exact time is important (car PC, weather station, etc.). A so-called **Realtime Clock** (RTC) module can help: Once initialized, it saves the current time – even if the power supply is not present – due to the small battery.

Raspberry Pi Sensors – Wireless / Infrared (IR) / Bluetooth

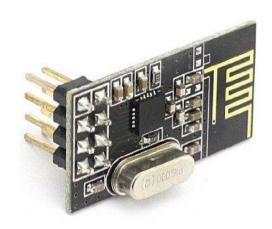
433 MHz Set



One of the simplest method to transmit signals via radio are 433 MHz transmitter and receiver. Since these sets are very cheap, they are used in many projects. So you can for example let several Raspberry Pi's communicate with each other.

Many other devices work also with 433 MHz radio signals, such as garage doors or radio controlled outlets, and these codes can be recorded and sent for specific tasks.

2.4 GHz NRF24L0I+ Module



A more advanced method for wireless communication is the use of the 2.4 GHz frequency. The advantages compared to the 433 MHz transmission rate are mainly that a larger amount of data can be transferred at once. Thus, whole sentences and commands can be sent with a signal / data package. A second Raspberry Pi or an Arduino can also be equipped with a 2.4 GHz receiver / transmitter and thus receive commands from a "base station" and send back data.

Si4703 Radio receiver



The Si470x module offers the option to upgrade the Pi to a radio receiver, which can be very interesting in Car PCs or Raspberry Pi Jukeboxes. As with conventional radios, the frequency and certain options can be adjusted (via software). If that is not enough, you can also use your Pi as a radio station.

Bluetooth Adapter



The Raspberry Pi has not always had an integrated Bluetooth module. Before the model 3 was published, neither Bluetooth nor WiFi modules were onboard. The inexpensive Zero model also comes without a Bluetooth adapter. Since almost every mobile phone supports this communication method as standard, it is so easy to exchange pictures and other files between the smartphone and Raspberry Pi. Other projects such as controlling the Pi via Bluetooth commands are also possible.

GSM Surfstick



The Raspberry Pi is used in many outdoors projects, e.g. as a weather station or for monitoring certain things. However, even if no (or only a weak) WIFI signal is available, many functions are restricted. If you still want to have access to the Pi and also receive the data of such an outside project, an Internet connection is necessary. The mobile surfsticks, which are also often available as gifts for data rate contracts, can be useful. With such a stick and a SIM card with data volume, the Pi can be permanently online. In addition, it is also possible to use the stick to send and receive SMS, for example to remotely control the Raspberry Pi by a mobile phone.

Infrared diodes



Most remote controls use infrared LEDs to transmit signals. These codes can be read and stored easily with an infrared receiver. With the program LIRC, it is also possible to send those codes with an IR transmitter diode. For example, a TV can be controlled with the Raspberry Pi.

Laser Module



Although standard laser modules do not have great functionality (can be switched on and off), they are used in various interesting projects. Thus, for example, there are projects of distance measuring devices, which are using a camera and a laser module. The laser is switched on and off very quickly and pictures are recorded. The distance can then be calculated by means of the beam set.

Servo Motors



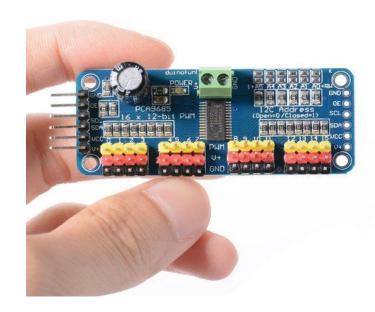
Unlike ordinary motors, servo motors can be individually controlled. Only the indication of the angle of rotation for moving the motor is necessary. PWM (pulse width modulation) signals are sent to the motor. The Raspberry Pi can use this method of transmission. Using the Python GPIO library or WiringPi is particularly easy.

28BYJ-48 Stepper Motor



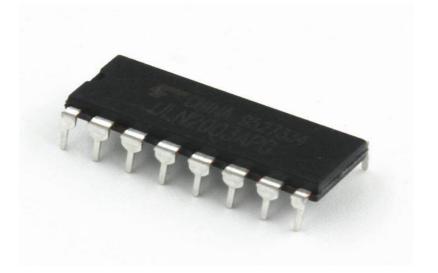
Step motors are motors that can "go" a certain number of steps in one revolution. Two electromagnets are built in, which move the axis through different poles. How the polarity looks like is written in the data sheet of the motor.

PCA9685 Servo Board



Using PWM, servos can be controlled directly from the Raspberry Pi. However, as soon as you want to control several servo motors, either the GPIOs can become scarce, or you need more power. The PCA9685 servo driver board is ideally suited for this purpose

ULN2003



Those 28BYJ-48 stepping motors are often supplied with a driver board. The supplied board usually has a ULN2003 IC, which holds the voltage for the 5V motor, but can be controlled with 3.3V. This is important because the GPIOs are protected and no transistor or relay is needed.

Raindrop Sensor



In order to determine whether it is raining or how much rain is present, a rainwater sensor can be used. It works analogously and can be read with the MCP3008. Depending on the amount of water, the capacitance is increased and a stronger analog signal is read out.

Heartbeat / Pulse Sensor



With a pulse sensor, the heart rate can be read out on the Raspberry Pi. The analogously detected value changes, depending on the pulse beat. This is again converted with an ADC and the pulse is determined on the basis of the last measured values.

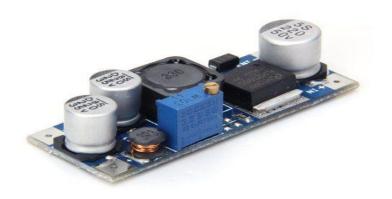
Power / Current Supply

Relays



The GPIOs of the Raspberry Pi work with 3.3V, although it also has a 5V pin. However, many devices require a higher voltage. In order not to combine the circuits, one can use relays, which are basically switches. This has the advantage that you can also switch circuits with higher voltages with the Raspberry Pi, without risking something.

LM2596 Buck Converter / Step Down Module



With the LM2596 (and similar) modules, higher voltages can be regulated downwards. For example, you can regulate the current of (rechargeable) batteries to the required 5V USB input voltage. However, no alternating current (AC) is allowed, but only direct current (DC), as supplied by batteries.

Official 7" Touchscreen



In September 2015 the Raspberry Pi Foundation introduced the official touch screen display after a long time. It has 7" at a resolution of 800×480 pixels. The 10 point capacitive touchscreen is connected through the DSI port and doesn't occupy any USB ports or GPIOs. The inital startup is very easy and you even don't need additional software (only an actual version of Raspbian or NOOBS).

3.2" Touchscreen



Not everyone needs 7 "or larger displays, sometimes a smaller touch screen is also enough, but the choice is relatively large. Sizes between 2.4 and 4.3 inches are very common, but these modules have almost exclusively resistive touch, You can connect them, depending on the model, via the GPIOs or (if available) directly via HDMI.

7 Segment Display



7 Segment displays are often used to display numbers and, as the name implies, have seven luminous segments, which can be addressed individually. In order not to occupy too many GPIOs, one usually takes a controller like the MAX7219.

Optical Fingerprint Sensor



Fingerprint Sensor can be used to implement safety-relevant applications. For example, the fingerprints of different persons are stored and authorization rights are given to them. Electronic saves or door locks can be built. A password can also be requested in conjunction with a numbad.

KeyPad / Numpad



A numeric input field is required for vault or code lock projects. For this there are own modules, which look like a numpad on the PC keyboard. These modules are available in different sizes (3×4, 4×4, etc.) and can be read directly at the Raspberry Pi. By entering certain numerical codes / combinations, you can execute secret actions

Official Raspberry Pi Camera Module



In many Raspberry Pi projects, cameras are also used. In this case, customary USB webcams can be used, but their quality is often not very good and also it occupies a USB port. A better alternative is the official camera module of the Raspberry Pi Foundation, which can be directly connected via the CSI port. The module is available in two versions: With (green) and without (black) infrared filter. The lack of an infrared filter allows a higher light sensitivity, which results in better images at dusk / night.

Photoresistors



In addition to conventional resistors and potentiometers, there are also photoresistors. These have a light-sensitive surface and have a different resistance value, depending on the light intensity. They can be used, for example, to detect day / night or to build light barriers.

Questions ???