# Detailed specification of components

## Microcontroller

The Venus exploration robot has an Arduino Uno (ATMega38P-based) microcontroller at its core.

Arduino Uno runs at an operating voltage of 5V, has 14 digital I/O pins, 6 PWM-digital I/O pins, 6 analog input pins and uses the AVR-architecture.

The Arduino Uno can be programmed using the “Arduino Language”, a language that is ‘transpiled’ to C and then compiled using ‘avr-gcc’ (a version of ‘gcc’ specifically for the AVR-architecture). The language is essentially a subset of C that hides some of the less intuitive parts of the AVR architecture from the programmer. Arduino Uno does not allow for concurrent programming, but does have a system in place for software interrupts, allowing the programmer to schedule periodic tasks (e.g. checking the input of a sensor).

## Actuators

### Wheels

The robot has two wheels; each wheel is driven by a separate electronic motor.

The speed at which a wheel turns can be modulated using a PWM-signal. Below the maximum speed, it is not possible to directly control the speed at which the wheel is turning. This would require some feedback or tracking system. The signal sent to the wheel will only control its acceleration.

### Servos

The robot has two servos, one to control the grabbing of objects and one to control the angle of the ultrasonic sensor on top of the robot. A servo is an electronic motor that uses a servomechanism to provide itself with negative feedback, allowing for very precise control of the angle made by the motor mechanism.

This angle is dictated by a PWN-signal.

### IR-LEDs

An IR-LED (Infra-Red Light Emitting Diodes) will emit infrared light when a current is flowing through it. IR-LEDs act much like regular diodes.

## Sensors

### IR-sensor

Infra-red light is a type of light with a frequency close to red light, but outside of the visible spectrum. An IR-sensor will measure the intensity of red light – from all directions – cast upon it.

The effective range (i.e. the range from which IR-light may be emitted for a significant measurement) is 100cm for detection purposes and 20cm for analysis purposes.

### Ultrasonic-sensor

An ultrasonic sensor (HC-SR04) will check the time it takes for a self-emitted ultrasound wave to reflect back to itself. This allows for precise calculation of distance.

The ultrasonic sensor has two ports involved in measuring a distance, ‘echo’ and ‘trigger’. When the ‘trigger’ port has a HIGH voltage applied to it, then it will emit ultrasound waves. The ‘echo’ port will serve as an input to the microcontroller. The difference between the point in time when a sound was emitted and the point in time when the sound was reflected and detected allows for calculation of the distance the sound has travelled.

It should be noted that the ultrasonic sensor on the Venus explorer robots is located on top of the robot, and there is no possibility of tilting it in a downwards angle. This means that the robot can only be used to detect objects that are tall enough to ‘catch’ the ultrasound emitted by the sensor.

The range for this specific sensor is 2cm to 300cm.