Name: \_\_\_\_\_\_\_\_\_\_ Class: \_\_\_ Date: \_\_\_\_\_\_\_\_

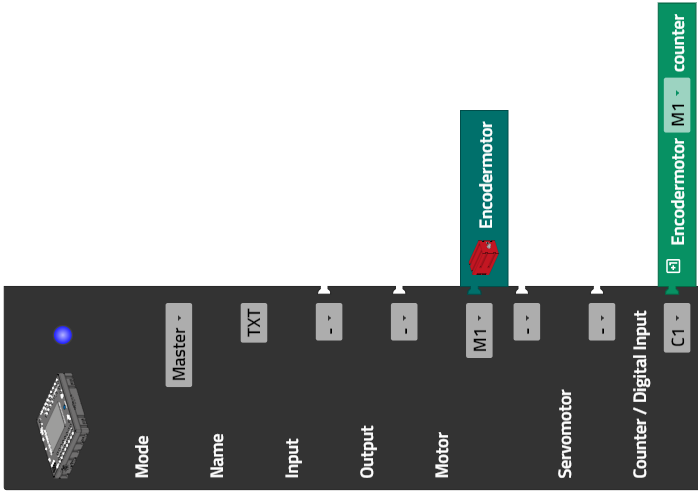
# Solution sheet task 1

# Tachometer, odometer and taxi meter

*The distance travelled per impulse must first be determined based on the tire circumference, encoder signals and gear ratio for the tachometer and odometer. This is not a difficult calculation, but an exercise in converting units. The speed information for the following suggested solutions is provided in m/h, but it can also be converted to km/h.*

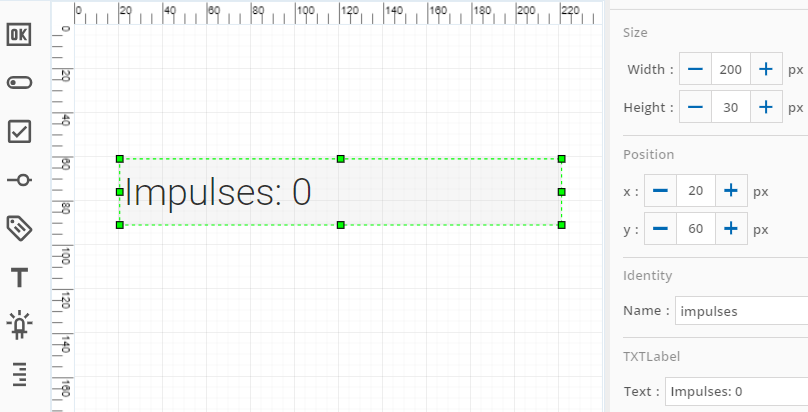
## Programming tasks

Configuring the actuators (only the encoder motor is required in this task):

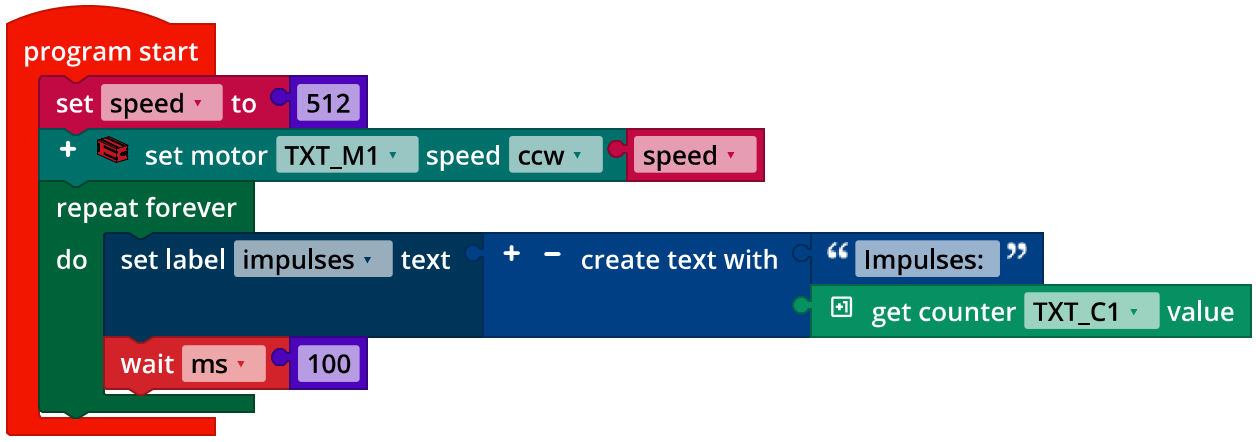


**1. Displaying the encoder values**

Display configuration:



Program (example) to display the counter values for the encoder:



*Display\_Counter\_Encoder.ft*

The pause in the loop ensures a controlled and continuous display. If it is left out, the controller will try to compensate for the delay through what is shown on the display.

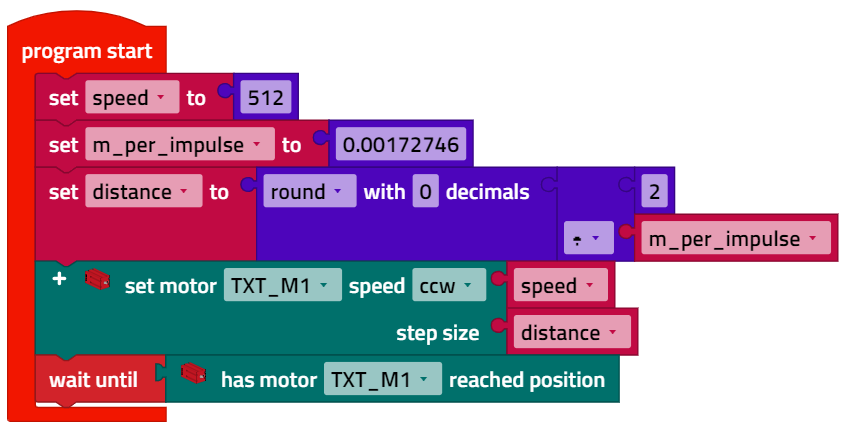
**2. Odometer**

The magnetic encoder of the motor delivers 63.9 impulses per revolution of the drive axle. The gear of the differential cage causes the vehicle to gear down by a gear ratio of 14:26 = 7:13.

2a. The circumference of the tire is approx. 20.5 cm (see task 6 from the Robotics TXT 4.0 Base Set; recommended measurement method: place the edge of a piece of paper around the tire, mark the circumference, and then measure the edge to the marking).

The impulses counted over a distance travelled can be used to calculate the distance (in m) based on the following formula:

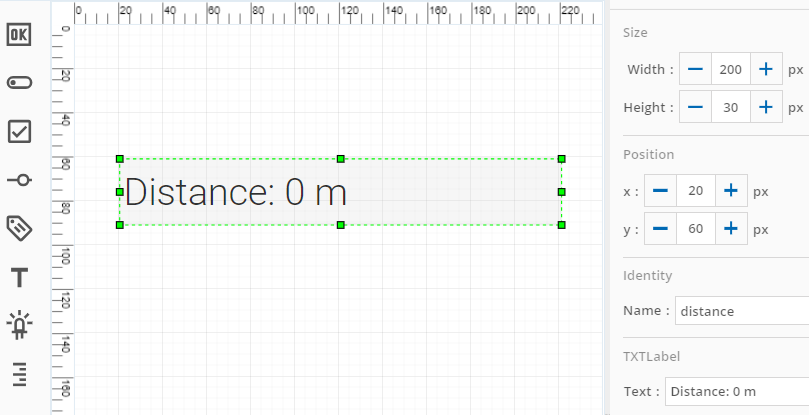
2b. Simple test program to check the measurement:



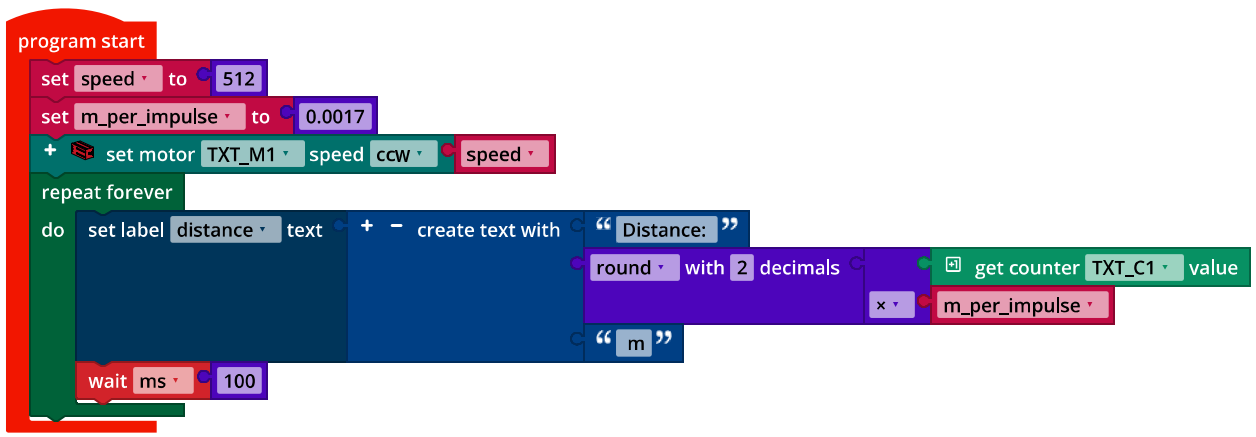
*Distance\_Test.ft*

In tests, the vehicle stops a short distance before reaching the 2m mark. The conversion factor was therefore corrected to 0.0017.

2c. Display configuration:



Program (example) odometer:



*Odometer.ft*

2d. The maximum measurable distance travelled is

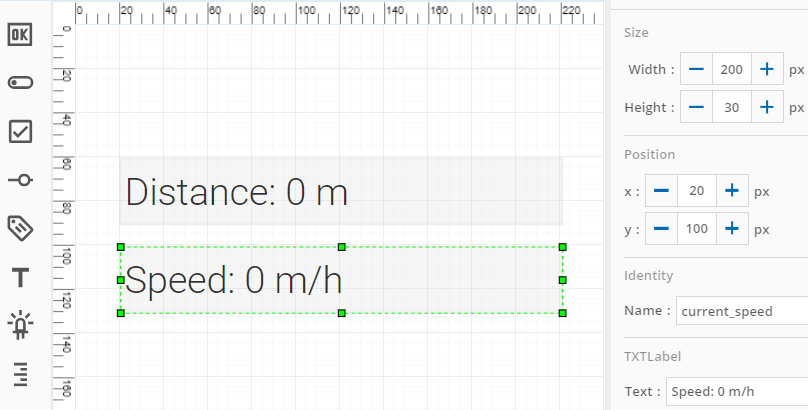
**3. Tachometer**

1 s can be used, for instance, as a fixed interval to determine speed: this is long enough for a precise measurement, and short enough to react quickly to changes in speed.

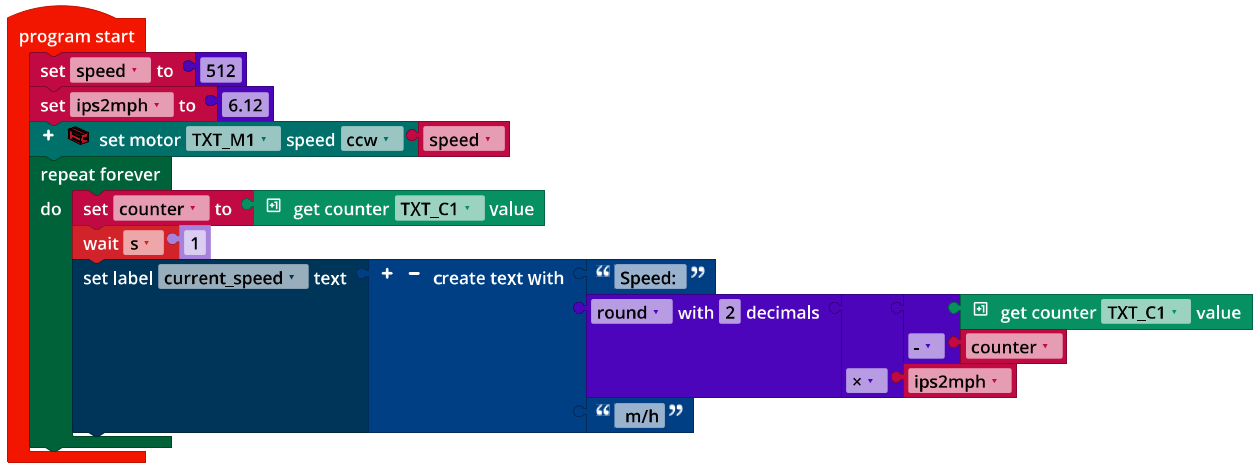
3a. Therefore, the speed can be calculated from the impulses counted within a second as follows:

If we take the corrected value from programming task 2 into account, then we have:

3b. Display configuration:

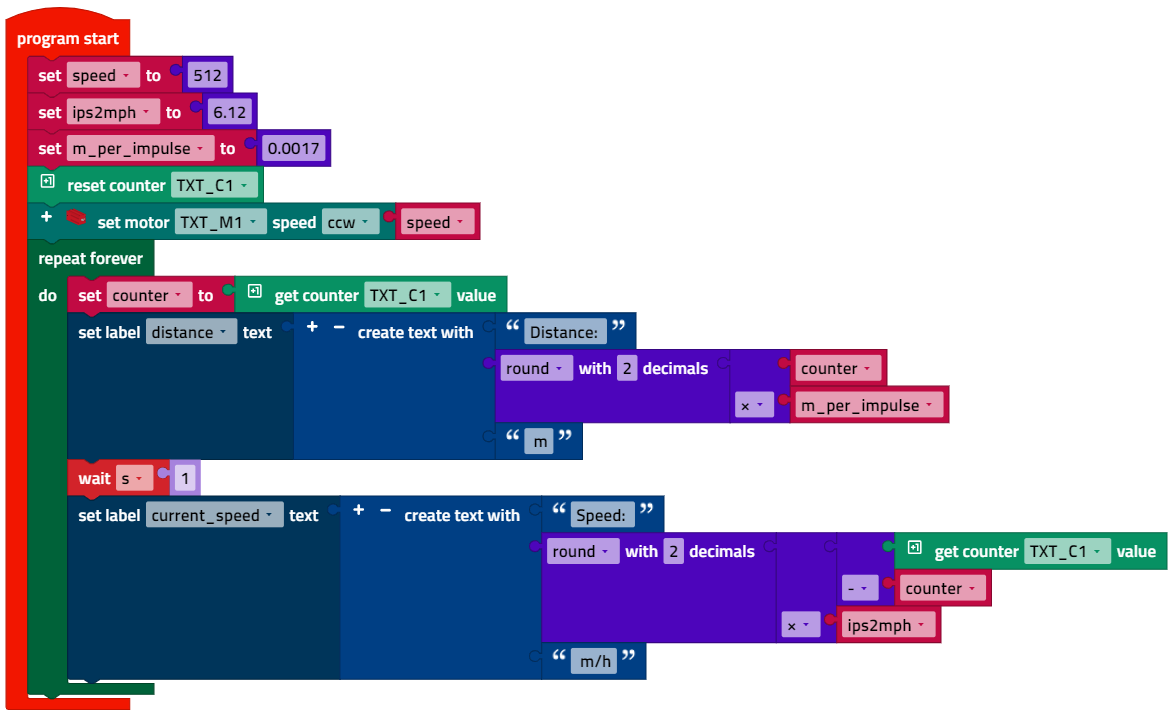


Program (example) tachometer:



*Tachometer.ft*

Program (example) odometer and tachometer:

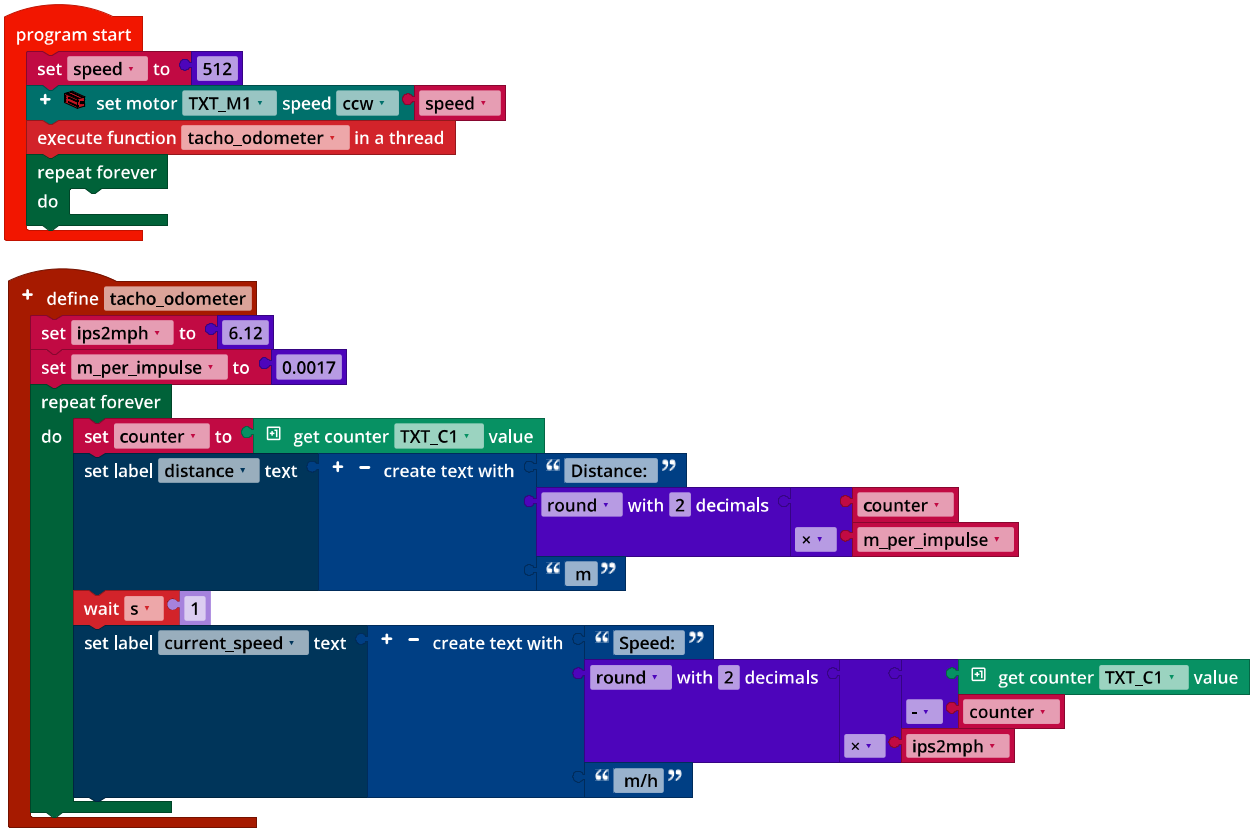


*Tachometer\_and\_Odometer.ft*

## Experimental tasks

**1. Tachometer and odometer concurrent**

Program (example):

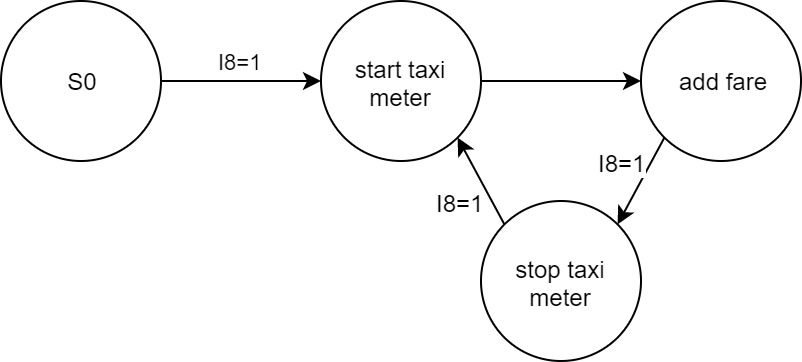


*Tachometer\_and\_Odometer\_Thread.ft*

**2. Taxi meter**

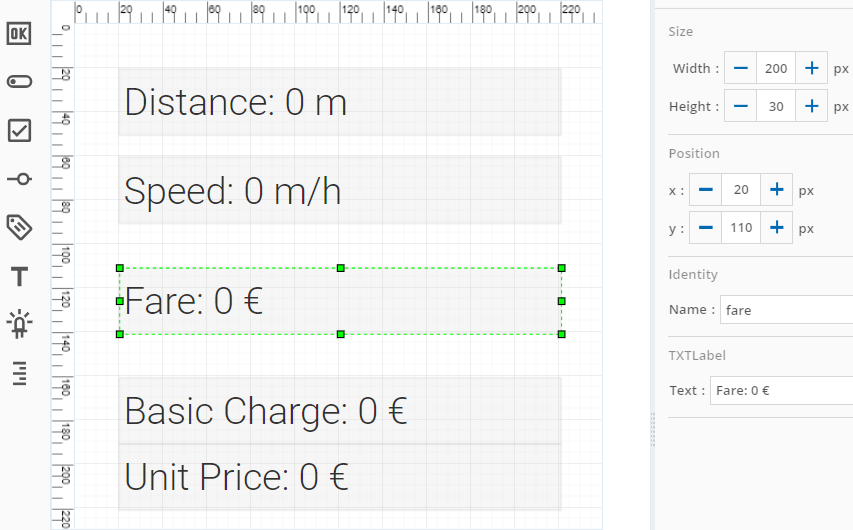
2a. Since the scale of the vehicle model to a real vehicle is around 1:10, it is a good idea to indicate the price for a distance of 100m for the taxi meter, for instance 2 €/100 m, with a 3.50 € base fee.

2b. State diagram:



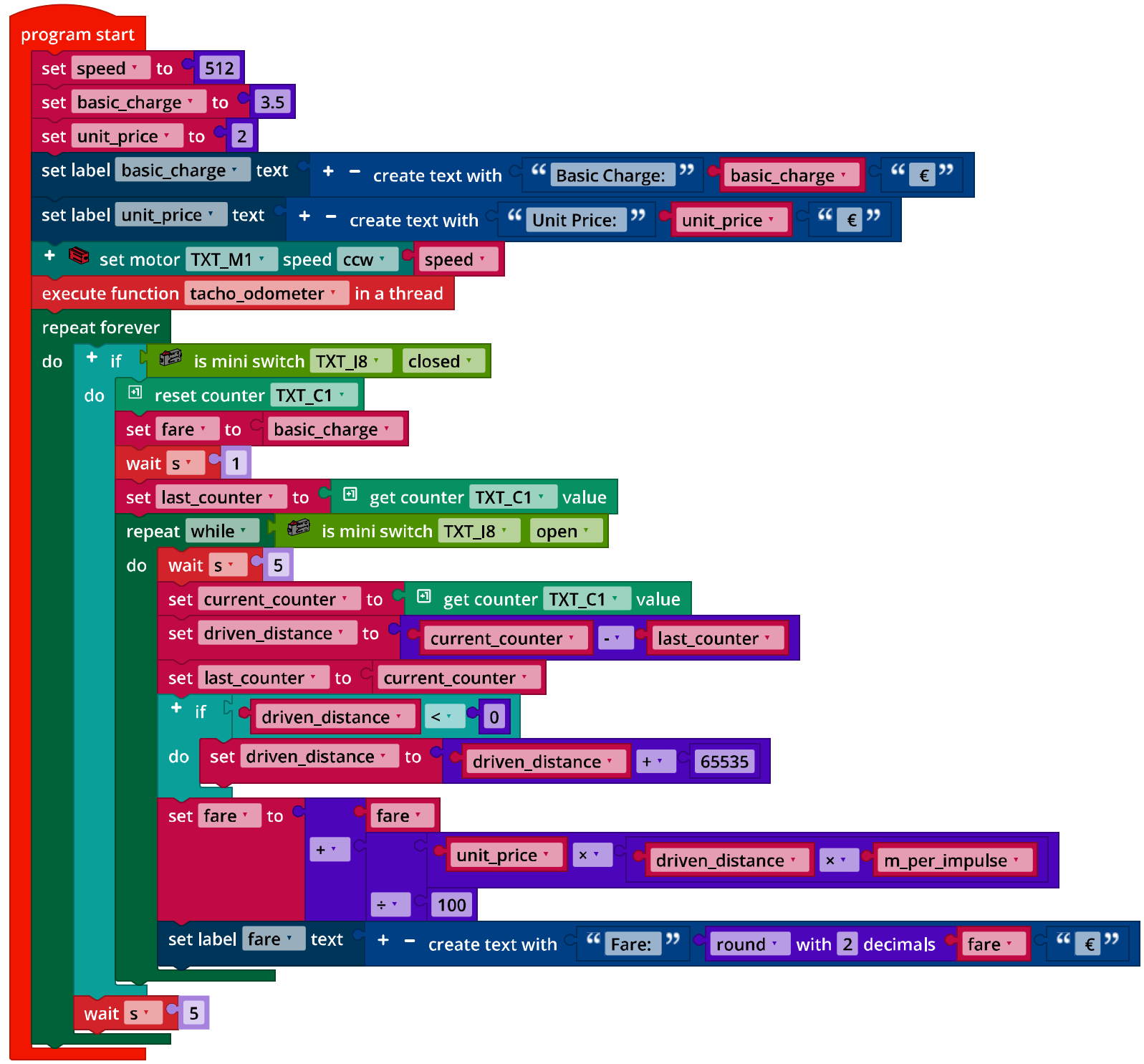
*State-Transition\_Diagram\_Taxi\_Meter.drawio*

2c. Display configuration:



The encoder impulses are only counted up to 65,535. Therefore, the trip price should be added up regularly, for instance every five seconds.

Program excerpt (example) taximeter:



*Taxi\_Meter.ft*

You can also move the taxi meter to a concurrent process (thread). It will then simply run alongside the tachometer and odometer while vehicle navigation is handled in the main program.

Annex

# Task 1: Cruise control, odometer and taxi meter

## Required materials

* PC for program development, local or via web interface.
* USB cable or BLE or WiFi connection to transmit the program to the TXT4.0.
* Tape measure or ruler, paper strips (to measure the tire circumference).

## Further information

[1] Andreas Wolf: [*Tachometer. Die Geschichte eines unverzichtbaren Instruments*](https://www.eurotransport.de/artikel/tachometer-geschichte-eines-unverzichtbaren-instruments-6565752.html). 04.08.2014.

[2] Alper Aribal (SeoRocket): [*Taxameter*](https://dewiki.de/Lexikon/Taxameter). DeWiki.de.

[3] Online diagram editor for creating state diagrams (Format drawio): <https://www.diagrammeditor.de/>