Test Title

Name: Group 510
Date: ??/?? - 2015

Purpose

The purpose of the module test. If testing specifications, include these here.

Setup

Input a diagram of the test setup:

List of Equipment

Example of list of equipment:

Instrument	**AAU-no.**	**Type**
Oscilloscope	52773	Agilent 54621D
FPGA		Spartan-3 (Chip:xc3s1000)
Laptop		

Procedure

1. write each step as done after setup - if there are different configurations of setup remember to include these.

Results

Example of results:

	Expected Result	**Result**
Frequency	49.5 - 50.5 Hz	50 Hz
Ammplitude	3.1 - 3.4 V	3.3 V
Pulse Width: Min	5 % (1 ms)	1 ms
Pulse Width: Med	7.5 % (1.5 ms)	1.5 ms
Pulse Width: Max	10 % (2 ms)	2 ms

Design & implementation

Design Consideration

In this chapter the system will be designed with a top-down approach. First a use-case of the overall functionalities in the system is described, in order to give an overall view of what the system must be able to do. Furthermore ..

Use case design

To give an overall view of what the system should be able to do, a UML use-case diagram is used to consider and describe the main functionalities and operators in the system, see **figure 0.1**.

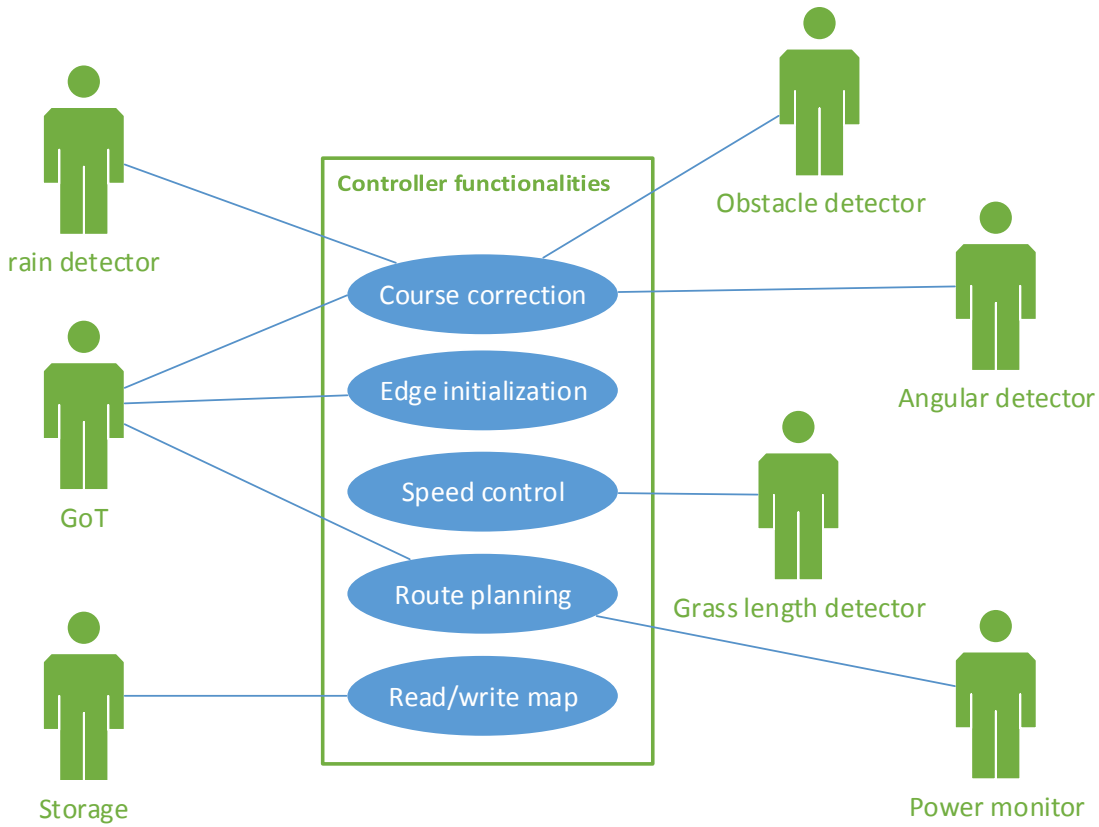

Figure 0.1: Use-Case Diagram

The main purpose of the system is to automatically navigate in a specific area.

In which area to navigate is set up by the *edge initialization* functionality. This functionality handles the marking of the areas edges. This functionality only has to be used in the initialization process of the system. The concept is to only use the functionality after the GoT system has been positioned in the area. The consumer then takes the system around the edges of the area, while the GoT system tracks its positions. It is therefore only necessary to used this functionality, and for the consumer to walk with the system around the areas edges, if the GoT system has been moved. While the edge is being tracked, the *edge initialization* uses the *store map* functionality to store the information collected, in storage.

The route to navigate after, in the specific area, is provided by the functionality *route planning*. *Route planning* uses the information, about the specific area, which is collected from the storage, to plan the most optimal route in which to follow. Furthermore the *route planning* needs information about the systems power level to insure the functionality is considering if the system needs charging and therefore have to return to the charging station at some point on the route.

The *store map* functionality as described earlier, handles the communication with storage. Hence it stores information, received from the *edge initialization* and collects information from storage when the functionality *route planning* needs it.

To insure the system is moving with a desired speed (in a straight line and in a turn) or a speed which is fitted to the height of the grass, detected with the *grass length detector*, a *speed control* functionality is necessary in the system. To insure the *speed control* can deliver the desired speed an *angular sensor* is utilized.

The last functionality, *course correction* is used when the system strays of the path calculated by *route planning* or if the path gets blocked. The obstacle which is blocking the route is detected by the sensor *obstacle detector*. Furthermore the GoT system and the *angular detector* will detect if the system is not on the desired path, or is the system starts to slip. Also, if it starts to rain, which is detected by the *rain detector*, the system has to return to the charging station. The *course correction* sends the calculated data to the functionality *speed control*. Hence the *course correction* is the brain and the *speed control* is the muscles.

The Games on Track GT-position system

Header

The Games on Track GT-Position system, shortened GoT, is a GPS system which uses radio-waves and ultrasound to locate the object. The system is build up by three hardware components, the transmitter, receiver and master.

Transmitter

The transmitter component is placed on the object, which needs to be located. To indicate the objects position, the transmitters emits out ultrasound waves to indicate where it and the object is positioned. The transmitter component runs on 2 AA-batteries and therefore does not need an external power-source.

Receiver

[1] The receiver component is placed around the area where the object, with the transmitter, has to be located. The receivers assignment is to search for the ultrasound waves, which the transmitter is emitting. The ultrasound waves received by the receivers, provides information containing the distance between the specific receiver to the transmitter located on the object. To be able to calculate the exact position of the transmitter and the object, a minimum of three receivers is necessary. however, more receivers can be added to the system for more reliability and the ability to cover a larger area. For the receivers to work at a high efficiency, they should be placed 1 to 2 meters apart. But if needed they can be placed up to a distance of 5 meters, however, this would affect the measurement and thereby make it less reliable. The receivers needs between 14 to 20 volt DC. Thus, making the receivers able to be powered through a computer charger if necessary.

Master

The master is a receiver which should be connected to a computer. The masters assignment is to receive the data transmitted from the individual receivers and send it directly to the connected computer. The master is powered through a USB cable, between the master and the computer.

Computer

The program on the computer, which handles the information received from the master, uses the data to calculate the position of the transmitter. This is done with a method call Trilateration. Trilateration is a way of calculating a position, in a three-dimensional space, from three distances (from known locations), with the help of spheres, circles and triangles. Therefore it is necessary for the system to have atleast three receivers, as mentioned earlier. With additional receivers a check up can be performed to ensure the position of the transmitter is correct.

If the receivers have been moved, it is necessary to calibrate the system. This is done with a calibration triangle.
[2]

[1] FiXme Note: What kind of "radio waves" does the receiver transmit data to the master?
[2] FiXme Note: How should the recievers be placed? how far can they reach, picture?

[3]

One of the points on the calibration triangle is made the origin (0,0,0) of a coordinate. Another point on the triangle will then be call (X,0,0), in which the line between the first point and the second point will become the X-axis. The last point will be call (X,Y,0) and will determine in which way the positive Y-axis will go. The surface which the calibration triangle is creating, will be the zero surface for the Z-axis, and is horizontal. The distance between the three points is measured and put into the software. Out from this data, the software can calculate the position of each receiver, with the help of trilateration.

List of Corrections

Note: What kind of "radio waves" does the receiver transmit data to the master? 6
Note: How should the recievers be placed? how far can they reach, picture? . 6
Note: How do you calibrate, do you move the transmitter around?? but that in the text 7

[3] FiXme Note: How do you calibrate, do you move the transmitter around?? but that in the text