Design report

# System level description

## Problem description

Our group was asked to design and program two robots, using a number of provided materials, which can execute a number of research tasks on Venus. The robots need to drive around on the planet and find as much research samples as possible in minimal time, while avoiding natural obstacles such as cliffs and hills. To simplify this assignment, a very abstract material model of Venus was made which will be used to test the behaviour of the robots. The model is summarized in the table below:

|  |  |  |
| --- | --- | --- |
| **Object** | **Known properties** |  |
| *Boundary*  Black tape | Absorbs infrared light. | C:\Users\hyper\Desktop\boundary.png |
| *Cliff*  Black tape | Absorbs infrared light. | C:\Users\hyper\Desktop\cliff.png |
| *Hill*  30cm high | Reflects ultrasound.  Absorbs infrared light. | C:\Users\hyper\Desktop\mountain.png |
| *Rock sample*  White cardboard  2x2x2cm | Reflects infrared light. | C:\Users\hyper\Desktop\rock.png |
| *Lab*  Box with ramp  2.5cm high  20x20cm floor area | Reflects ultrasound. | C:\Users\hyper\Desktop\lab.png |

Translating the problem statement in terms of this material model, the robots need to find and pick up the rock samples and drop these in the research lab while avoiding the hills, cliffs and boundary. The robots have to communicate with each other in order to complete this task as efficiently as possible.

## Strategy

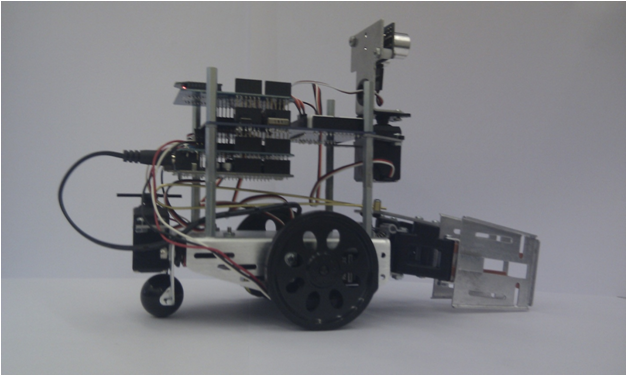
There are three relevant strategies of cooperation with the two vehicles.

1. Letting both of the vehicles simultaneously search the area for the rock samples and if a vehicle finds a tube it brings the rock to the lab. On this manner all the tube that are found are brought to the lab.
2. One of the vehicles is going to search for the tubes in the research area and drops the tubes at a fixed place in the field. The other vehicle waits until there is a tube at that fixed location and when there is, it brings the rock to the lab. Instead of letting the second vehicle wait in the beginning, it could also explore the area and also search for rock samples until there is found one rock sample.
3. Instruct one of the vehicles only to explore the area and communicate the locations of the rocks to the other vehicle. The other vehicle could than collet the tubes and bring them to the lab.

In order to know which strategy is the most efficient, or fastest, there should be performed some tests. With these tests we should investigate how much time certain jobs takes.

## The robot

The provided robot is based on the ‘Parallax Shield Kit’, which contains a basic metal construction, an Arduino controller, a gripper and powered wheels. On top of this, the robot has an ultrasonic distance sensor, an additional breadboard and a wireless communication module.



In order to be able to succesfully execute the strategy described above, the robot needs to fulfill the following requirements:

* It can drive around.
* It can pick up and drop research samples.
* It can communicate with other robots for efficiency.
* It has a mechanism to detect hills, cliffs, research samples, the research lab and the boundary of the given area.

The first, second and third conditions are easily fulfilled, since the provided ‘bare’ robot contains powered wheels, a gripper, and a communication module. For the last condition though, an additional sensor may be needed. The hills can easily be detected by the ultrasound distance sensor. This cannot be used for the cliffs, boundaries and samples though, because these do not have a sufficient height. The only known property of these objects which can be used to detect and distinguish them is the infrared reflectivity. Therefore it was decided to add multiple infrared reflection sensors to the robot (marked in red in the picture, to distinguish it from the components included in the basic kit). These sensors can also be used to find the research lab. The robot and its core components are summarized in the graph below:

A more detailed description of these core components and their positions will be given in the next section.

## Detailed specification of the components

Describe positions of sensors/actuators (+ how many), include datasheets and specifications.

## Test and integration plan

## Planning

|  |  |  |
| --- | --- | --- |
| **When** | **What** | **Extra Information** |
| Week 1 | Task division.  Global setup.  Strategy Choice. | Deadline Design report 1-5-2016 |
| Week 2 | Programming basic Utilitarian functions.  Examining robot functionality  Writing Design Report | Ordering extra components |
| Week 3 | Testing Basic functionality Robots.  Developing main Algorithm  Start of writing Final Report  Making a task division |  |
| Week 4 | Continuing development of strategy  Developing main Algorithm  Implementing and programming of extra components  Begin testing fase | Expected delivery of extra components |
| Week 5 | Testing functionality and sensor accuracy  Making of video presentation |  |
| Week 6 | Testing functionality, sensor accuracy and speed sufficiency  Making of video presentation |  |
| Week 7 | Testing functionality and sensor accuracy  Finishing video presentation  Finalizing Complete project | Deadline video presentation: 16-06-2016  Deadline Final Report:19-06-2016  Demonstration:17-06-2016 |