Robotics 24/09/2014

Full Name _____

Question 1. Shortly describe the working principle of the MEMS gyroscope.

Question 2. Explain, providing and commenting an example, the problem of the priority inversion due to shared resources in a real-time system.

Question 3. Using the extended Finite State Machine (FSM) model, design the high-level control logic of a fire surveillance drone.
The task of the drone is to autonomously fly over a forest area and report whenever it detects a potential fire at the ground level. The fire can be detected by an infrared camera. The camera provides an digital output signal whose value is 1 if a fire is detected, while it is 0 if not. The alarm is sent by radio to a dedicated control room. The drone takes off from and lands to its home station. During the stay at the home station, the battery is recharged.
The high-level controller must drive the drone back to the home station safely, i.e., before the battery charge is exhausted. The drone must consider the current distance from the home station and the left battery charge. Assume to have a builtin function `dist_to_charge(dist)` that, given a distance `dist`, returns the amount of battery energy required to travel that distance.
The drone is equipped with:

- infrared camera,
- a GPS,
- a radio,
- an analog battery level sensor,
- a docking sensor (1 - the drone is docked at the home area; 0 - otherwise).

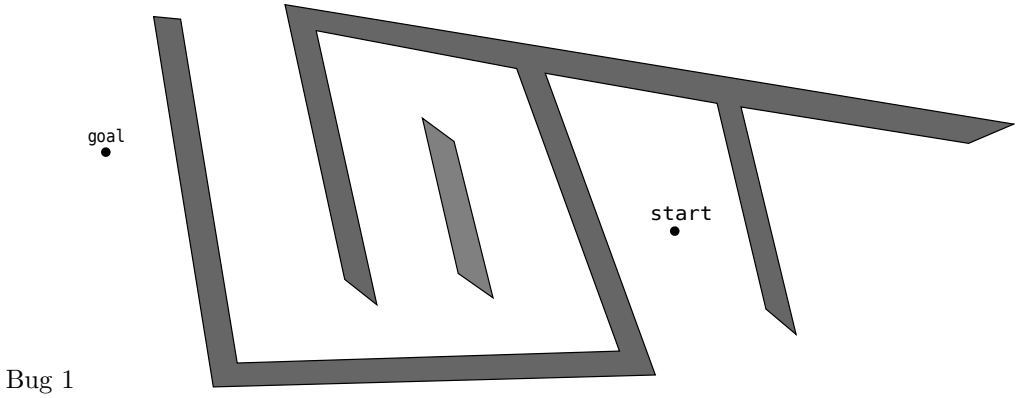
The outputs of the control system are the following function calls:

- `explore()`: take off and explore the area;
- `go_back()`: return to the home station and land;
- `report(MSG)`: send a message via radio to the control room.

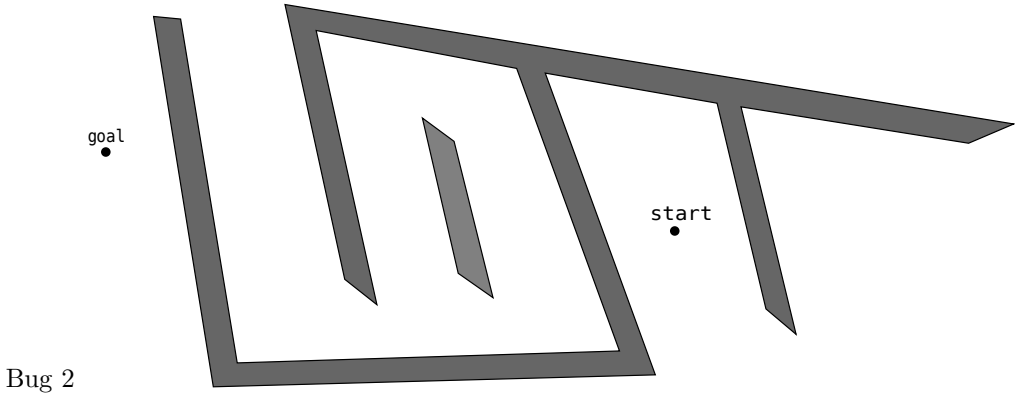
It is possible to choose the FSM type (Mealy or Moore, explicit the choice) and the representation (graphical or tabular), showing: inputs (events), outputs (actions) and state variables (if any). Indicate further appropriate assumptions, if needed.

..:: CONTINUES ON THE OTHER SIDE ::..

Question 4. Considering the worst case, show the path generated by the Bug 1 and Bug 2 algorithms in the following configuration space (the calculation of the path length is not required).



Bug 1



Bug 2

Question 5. Shortly explain the working principle of the Network Time Protocol.