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SPECIAL GUEST

GORDON BENNETT GAS BALLOON 2D AND 3D -GAME

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Landing as far as possible from the launch place is the goal of the Gordon Bennett and America's challenge gas balloon races. All the teams competing in the race have the same amount of lifting gas (usually 1000 m3 of hydrogen or helium), they choose their flight equipment and embark sand to balance the buoyancy force. The balloonists can only change their altitude by dropping an amount of sand or by releasing some of the lifting gas. The goal is to find the best winds (which differ in amplitude and direction according to altitude) to save their resources (sand and lifting gas) in order to stay longer in the air. The oldest and most famous race of this type is the Gordon Bennett race which took place for the first time in Paris in 1906. In October 2017, the Freiburg-Fribourg Challenge team, with the pilots Laurent Sciboz and Nicolas Tièche, supported by the HEIA-FR and the 4P **[1]**, broke the distance record of 3400.39 km held for 12 years by the Belgian team Berben & Siméons: they reached a distance of 3670.76 km in 59 hours and 35 minutes during the America's Challenge, the second major gas balloon race.

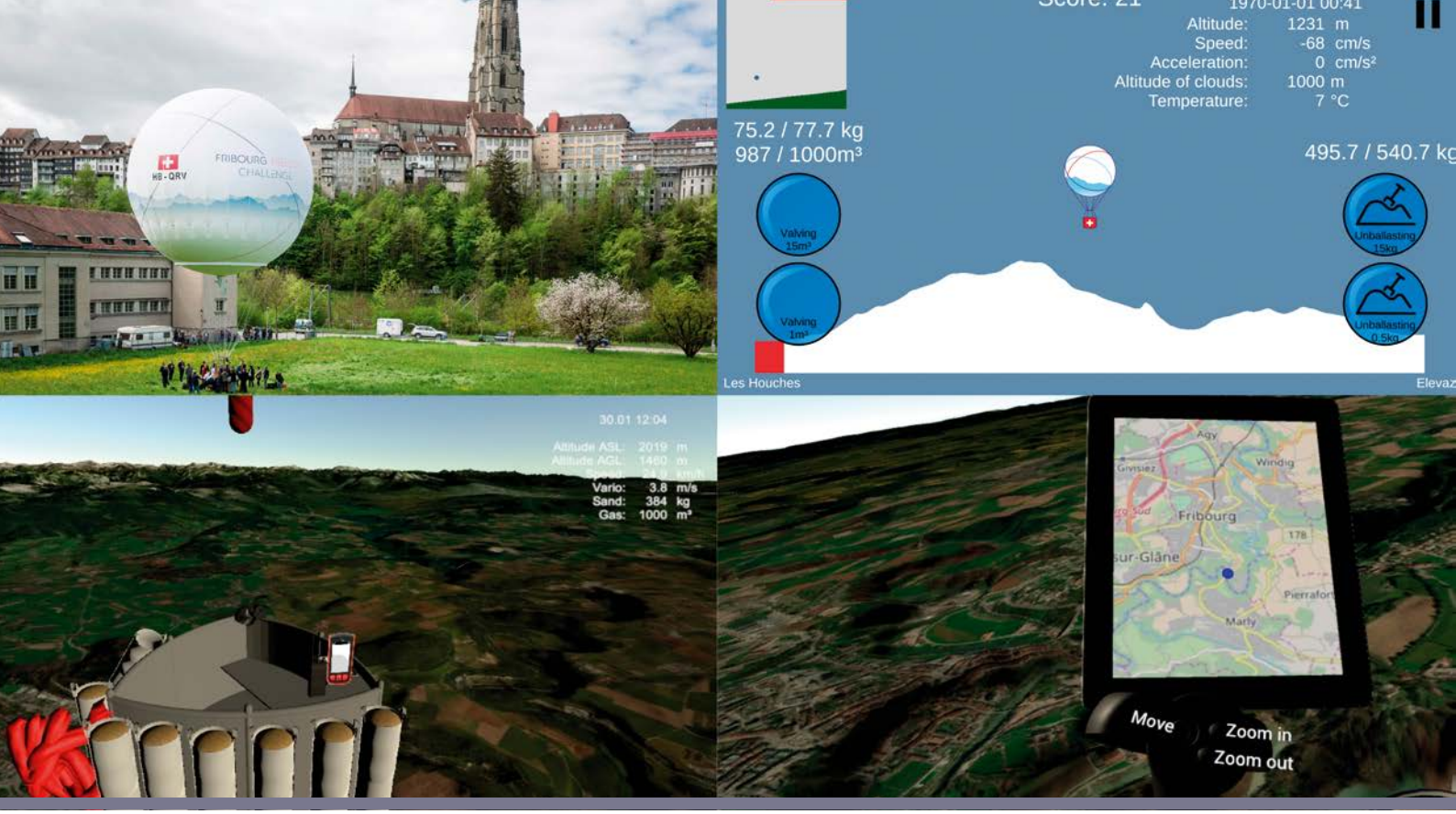
Two different software, based on the Gordon Bennett rules and using the Unity 3D game engine, have been developed at HEIA-FR.

Travel the longest distance using the least possible resources

A **2D game** has been created to promote gas balloon races and enable players understand how these balloons work. The game incorporates realistic physics (as described in article **[2]** or **[3]**) to change the balloon vertical position according to the gas and sand usage. The difference between the lifting gas temperature and the one of the surrounding air must also be considered as their effects also influence (indirectly) the vertical motion of the balloon.

In the game, the player has to travel the longest distance using the least possible resources. The player must also avoid stormy clouds and maintain his balloon within authorized air corridors. The player earns points for each travelled meter and loses points when sand is dropped or lifting gas released. Finally, the player must land with a vertical speed of less than 10 meters per second, otherwise the balloon crashes and all the collected points are lost. The game is also lost if the player enters a stormy cloud or flies at the wrong altitude while assigned an air corridor.

Several predefined races are proposed and the player can create his own races by choosing the points of departure and arrival. The real earth vertical terrain profile between both points is automatically recovered from Google services. The player can also change the race difficulty by choosing the available amount of gas at the beginning, the total number of areas where flight altitudes are restricted and departure time (day/night).



A **3D game/simulator** with the use of virtual reality has been created. This simulator takes into account the physics including the vertical movement thermal effects and the weather forecast for the horizontal motion of the balloon pushed by the wind according to the article [3]. The player chooses the simulation starting point and time. The available weather data as close as possible to this time is then loaded from NOAA's (National Oceanic and Atmospheric Administration) services [4]. NOAA provides weather forecast for a period of up to 16 days for the whole world. The Earth profile and satellite maps are loaded using MapBox [5] services. The landscape is then displayed in the most realistic way. In order to (virtually) fly the balloon, the player uses a controller device to drop sand from sandbags located around the basket or pull a rope that opens the valve at the top of the balloon and releases the lifting gas.

The player can use several instruments to read the position, the altitude (as a GPS would do), the height variation and the speed relative to the ground in order to take decisions to control the balloon route. Two additional measurements are also available: the remaining mass of sand and lifting gas. This information is not available in a real flight and must be estimated by the pilots. Finally, a map showing the distance travelled since the beginning of the flight is also given. In this simulator, the score is related to the bird's-eye distance between launch and landing points. If the landing occurs with too much speed, the landing is considered a crash and the score is not taken into account.

Real pilots have been using that game/simulator and have indicated that it is quite close to reality.

REFERENCES

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[5] MapBox. https://www.mapbox.com/

DEMO & POSTER

GORDON BENNETT GAS BALLOON 2D AND 3D-GAME

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Gordon Bennett 2D and 3D - Game

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The Gordon Bennett cup is the world's oldest and the most popular gas balloon race. The first race started from Paris in 1906. The aim of the contest is simple: to fly the farthest distance from the launch site with a balloon inflated with the same quantity of buoyancy gas (hydrogen or helium). The height of the balloon is controlled either by reducing the ballast (sand or water) or by releasing the buoyancy gas via a valve. The longest flight distance achieved in a competition is 3670.76 km.

Two distinct applications have been developped (using the game engine UNITY 3D) at the HEIA-FR based on the rules of the Gordon Bennett and a physical model of a gas balloon.

A 2D smartphone game

The aim of the game is to perform a maximum score. The player has to
•use a mimimal amount of gas and sand
•avoid stormy clouds
•respect air corridors
•follow a real topographic profile between the starting point and the end point

A 3D game

The aim of the 3D virtual (with headset and controller) simulation is to be as close as possible to a real flight:
•the flight can be done everywhere in the world
•real up-to-date weather data (NOAA forecasts)
•real topographic map (Mapbox)
•the player can drop sand and release gas or look at the flight instruments

2D game, try it

3D simulation of a gas balloon

he Gordon Bennett cup is the world oldest and most popular gas balloon race. The first race departed from Paris in 1906. The aim of the contest is simple: fly the farthest distance from the launch site with a balloon inflated with the same quantity of buoyancy gas (hydrogen or helium). The balloon altitude is controlled either by reducing the ballast (sand or water) or by releasing the buoyancy gas via a valve.

In October 2017, the Freiburg-Fribourg Challenge team supported by the HEIA-FR and the 4P broke the 12-year-old distance record and set a new one with a distance of 3670.76 km travelled in 59 hours and 35 minutes at the America's Challenge, the second major gas balloon race.

At the HEIA-FR, two distinct applications have been developed (using the game engine UNITY), based on the rules of the Gordon Bennett and a physical gas balloon model.