Science on a Sphere
Ways of Adding Interactivity into the Unique Projection System

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Abstract: This paper describes applied research provided in cooperation of the Faculty of Applied Sciences and the Techmania Science Centre. It presents the unique system Science on a Sphere, its features, control mechanisms and limitations. The special visualization system brings a new approach of geographical data presentation. On the other hand it offers just a minimal opportunity of user interaction. Interaction should enable better participation of science centre in the learning process. The paper shows the ways how the existing projection system Science on a Sphere has been extended for the interactive features.

1 INTRODUCTION

Science on a Sphere (SOS, 2014) is a science project of the National Oceanic and Atmospheric Administration (NOAA) agency (NOAA, 2014). It was developed as an educational tool that should enable better illustration and visualization of geography, history or any atmospheric processes on Earth and other planets. In fact, it is a large visualization system composed of projection sphere and four video projectors connected to the computer. Projectors are placed sophistically around the sphere and displaying animated data on the sphere surface and so the system has an effect of luminary globe. The simple scheme of the system can be seen in Figure 1.

SOSs are mostly placed in science centres, museums and universities. All of them can use over 400 datasets categorized in several groups. Datasets are produced directly by the NOAA as a visualization of data measured by several different types of satellites, including geostationary and polar orbiting satellites. Some datasets (e.g. temperature, weather or wind speed) are real-time, they are actualised online according to actually measured data just with approximately one hour delay. Moreover, not only official datasets can be projected, users can produce their own visualizations based on video or image data.

Over one hundred spheres are installed worldwide, most of them are placed on the North America Continent. In October 2013 the seventh SOS in Europe was installed in the Czech Republic, in Techmania Science Center in Pilsen (TSC, 2014). The sphere has diameter 1,73m and is placed in a separate dome of the planetarium building. This equipment was used for development of the SOS interactivity system described in this paper.

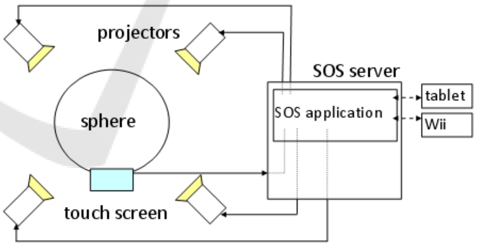

Figure 1: Scheme of SOS.

SOS is the unique equipment that is ideal for visualization of geographically and planetary data especially for educational, science communication and visual analitics purposes. But because in its original state it can be used only for replaying prepared datasets, it has very limited usage. The whole projection is controlled by the SOS server and the system does not enable to change its function or to access directly the visualization part. The user can influence the view (the globe rotation and the visualization stop and replay) from a remote device, such as tablet application, touch screen or Wii Remote. In our approach we have focused on design of extension of the user interaction with SOS.

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Suggested approach was demonstrated on the implementation of the educational game.

Section 2 describes the ways how SOS can be controlled, Section 3 deals with reasons why and ways how to add interactivity into the existing system and its usage in education game is shown in Section 4. Finally, Section 5 concludes the paper and outlines our possible plans into the future.

2 SCIENCE ON A SPHERE

The basic element of the SOS visualization is a dataset, or we can call it a clip. Clips are combined into playlists and among clips in the playlist users can simple switch during the SOS viewing (as described in Section 2.1). In dependence on the way of SOS control that we use, we can manage more or less limiting set of functions for the globe control.

2.1 SOS Control

There are several ways how to use the whole system. The basic approach is to view the prepared datasets downloaded directly from the NOAA (SOS, 2014). Three examples can be seen in Figure 2.

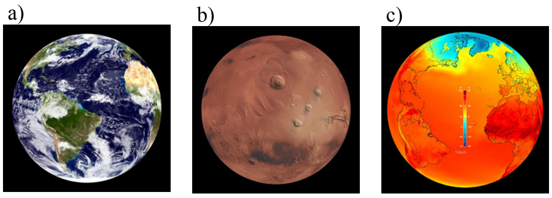


Figure 2: a) Blue Marble (23 degree tilt); b) Red Mars (25 degree tilt); c) Surface Temperature.

The view control can be provided on the touch screen that is placed directly next to the sphere. Everybody can select any dataset from the prepared list and start its playing. The viewed clip can be tilt, paused and released again. Similar opportunities of control (but in a more movable way) are offered by the usage of Nintendo Wii Remote. The advantage is that SOS can be controlled from any place in the room and the operator can better view the globe, walk around it and see anything he/she wants.

Much more advanced option of control is the usage of tablet. User of the tablet application connected to SOS can switch clips, rotate the globe in any direction, zoom or use simple drawing to highlight some interesting places. Also layers used on the sphere can be explored, hidden and showed again. This approach is used by the trained operator of the SOS (most often the edutainer – guide in the science centre).

The only possibility to influence the SOS system completely is to send one or more of the predefined commands to SOS server terminal via telnet protocol. This approach is called automation (SOS – automation, 2014). There are tens of commands that can influence the globe (e.g. insert pictures, set its size, position, style, name, add or remove layer, get current state of the system and many others). Because commands have to be entered in a proper format and various settings should be observed, it is not a user friendly way of SOS control for a common user. But it is the most complex way.

To summarize it, the SOS offers various kinds of datasets visualization, but for the non-trained user (the visitor) there is absolutely no way how to interact with the device except for switching and replaying clips.

2.2 SOS Abilities

Base of any dataset can be composed from image or video wrapped around the globe. Aspect ratio of the base should be 2:1. SOS offers many features that can be used for the dataset modification. The original data can be overlaid by some additional proper layer image, pictures in picture can be added on a particular place on a globe, speed and angle of rotation can be specified etc. We can work with audio, sphere orientation, zoom and annotation, we can switch datasets, etc. As mentioned above, some features can be affected directly in the dataset description or we can use automation control. For our work we have selected a set of several important functions, they are described in following sections.

2.2.1 Sphere Orientation

The orientation of the sphere is given in degrees as the vector of three values [rot_x, rot_y, rot_z]. But in fact, there are two coordinates systems – the globe and the room one. It is important to notify, which SOS feature uses which coordinate system. When the sphere orientation is set as [0, 0, 0], the way of specifying a position on the sphere surface is identical in both coordinate systems. If the globe orientation is changed, the room coordinate system remains in the original position, and the globe coordinate system shifts around (SOS – sphere orientation, 2014).

We can affect the speed of the sphere rotation and we can also set the exact tilt of the globe. Because the sphere rotation can be in the same time changed from several independent devices (tablet, Wii Remote or a touch screen), it is very important to get the actual state each time before any action.

2.2.2 Actual State

If we need to know, in which state the SOS actually occurs (what is the rotation of the globe, if it is rotating or not, if the pointer is visible, what is its position etc.), we can use the actual state automation command *get_state.* It returns description in a text form that can be further parsed. An example string can be seen here:

```
{timestamp 111} {pointerimage mmm} {pointersize
0.0} {clip_state LOADED} {clip_number 0}
{animating 1} {pointer 11.0,218.3} {tilt{0.0 0.0
0.0}} {frame_rate {30.0 0 0}} {playlist_name
nnn.sos} {frame_count 3600} {frame_number 656}
```

2.2.3 Pointer

Pointer is a tool that can be controlled just with tablet or automation commands. It is a point of a defined size or the single point can be replaced by an image. It can be hidden or shown and we can affect its position on the globe. Officially it has only one function in the tablet presentation – to specify the user actual position in the room, than the sphere is rotated relatively to him/her.

Very important is the fact, that if we move the pointer for [latitude, longitude] delta, it moves in the coordinate system of the room and so, if the globe is rotated, movement of the pointer does not keep the original direction of lines of latitude and longitude on the globe. The pointer moves vertically or horizontally on the globe, but according to the clip base image unwrapped to the 2D map it moves in an elliptical path.

2.2.4 Picture in Picture (PIP)

Picture in picture is a very useful feature, if we want to put image anywhere on the globe. We can choose from three styles of PIP – room (it is placed once on the globe and keeps its position relatively to the room even if the globe rotates), projector (each projector has its own image, so it is shown four times on the globe; images do not move when the globe rotates) and globe. The last one is the most useful type for our purpose. The picture is placed once on the globe and while the globe rotates, it keeps its position relatively to the sphere on the same place.

The orientation of PIP on the sphere is given by longitude (going horizontally from -180 on the East to 180 degrees on the West) and latitude (going vertically from 90 degrees on the North to -90 degrees on the South Pole) – see Figure 3. Top border of the image is situated always to the North Pole of the globe.

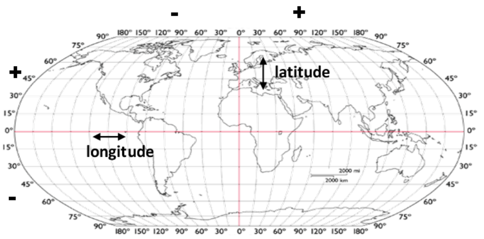


Figure 3: Longitude and latitude visualization (image base source: LatLon, 2014).

If we put the new PIP on the sphere, we can set various properties, such as size, alpha, position or style, we can change the source image or delete the PIP. But once we add any next PIP, the precedent one cannot be modified any more. To keep opportunity to change the properties of each single PIP also in the future, we have to set the PIP name and later we can select the PIP according to its name and continue in settings.

2.2.5 Layers

Layers are the second way of putting any image on the globe. It is placed over the basic layer of a dataset and should have the same aspect ratio as basic data. Several layers can be placed over each other and because they can use transparency, we can use layers for adding some new information to the basic content, for highlighting of some area or adding labels. Each layer has its index and very often its own name and can be shown or hidden via automation comments or during tablet presentation. The number of layers is not limited, but if we use high number of layers, the whole system slows down markedly.

2.2.6 Annotation

In Section 2.1 there was already mentioned, that users of tablet application can use some kind of drawing. System enables to choose the colour and width of the line and to draw line segments between two points, coordinates of the line segments end points are set in degrees of latitude and longitude. If we want to use annotation via automation, we need only to build a command such as:

```
annotation drawline 90,0,-90,0,2,255,0,0
```

It will draw the Prime Meridian as the red line of width 2 from the North to the South Pole. If the line segments are short enough, we can use them to create curves, but because all line segments are drawn subsequently, if many poly-lines should be drawn, it needs more time.

3 INTERACTIVITY

All approaches described in Section 2.1 enable to select any clip from the prepared datasets and view it. Moreover, edutainers can use tablet to zoom to some place on the globe or to draw simple on the actually viewed dataset, to show some interesting details. But there is no way how to interact with the sphere more, or how to enable children to join any game that will test their knowledge about the Earth, planets or any other interesting topic. Our first aim was to add to the SOS system a new feature which would enable visitors of the science centre to affect somehow what they see, to select any place and to get more information and to learn more simply by "clicking" on the sphere.

Because the SOS does not offer any tool, how to impulse it and to launch any action we had to search for another solution. SOS server is running online and is able to react immediately on the command sent via the telnet connection. It is the only way how to give SOS real time instruction about what operation should be provided. We have decided to create an external application that would get impulses from the user (via GUI or any special hardware) and at the same time it would send commands for the SOS directly to the SOS server over the telnet connection.

As additive hardware we have selected Nintendo Wii Remotes, because several pieces were already bought with the SOS system. As mentioned in Section 2.1, they have originally just very limited control function. And because they were not used at all, we were asked to upgrade their function. For the communication between computer and Nintendo Wii Remote the bluetooth wireless technology is used.

3.1 Interactive Features Concept

We need to implement two basic features so that any game or interactive application could be built on the SOS interactive module – clicking cursor (or multiple cursors) and places/areas determination.

The first feature is the cursor. A tool that would move on the globe and by clicking would run any actions. Moreover, if we want to use the system for any game, where more users would compete, we need to place more cursors on the globe and to control them separately and so we should extend the system for multiple cursors.

To select and mark interesting places or areas, we need to create any tool that would be able to border any selected area on the globe. Moreover, these areas should be clickable. It means that if the user will use the click action, the area placed on the position of the cursor will be able run the action. So we need a way to describe a continuous border, an algorithm to decide if the point (position of the cursor) is inside the border and some mechanism to show the area on the globe. Moreover, it would be useful so that the area could be marked as active, if the cursor is moving over the sphere (it means, if the cursor moves over the area, it changes its border colour and if the cursor leaves the area, border colour is changed back as the non-active area). To describe the border, it is sufficient to keep coordinates of poly-line vertices together with the name of the area. Coordinates can be used as for the border visualization and so for the inside decision algorithm. The detection algorithm works in two levels. Each area has its bounding box, and before exact test, if the point lies in the area, the bounding box test is provided. When it is positive, the ray-crossing algorithm based on the Jordan Curve Theorem (Schneider and Eberly, 2002) is used to determine exactly, if the point (position of the cursor) lies inside the polygon (tested area).

3.2 SOS Control Module

We have designed a module covering all the SOS control functions, telnet connection operations and also supporting functions for data preparation. This section describes approaches of using SOS abilities for the interactive use. The following subsections show an example of the model usage that was further developed and implemented into the form of complete workable system transferred into the real use (see Section 4). Also some facts about the real implementation of the model and reasons for technologies selecting are given (Section 3.3). The main idea of module integration and example of the module usage in the interactive educational game can be seen in Figure 4. The game server (created on the basis of the interactive module) is connected to the SOS server and ensures the automation commands processing. To the game server we can connect several Wii gamepads, each can control its own cursor and so the game server has to process the commands from various sources. The client application ensures the comfortable game selection, launching, switching of questions and the communication with the game server.

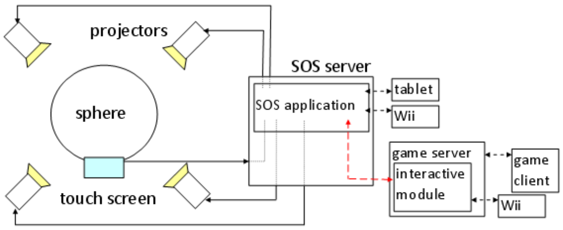


Figure 4: Scheme of SOS with the interactivity module.

3.2.1 Interactive Features Implementation

We have really very limited opportunities while adding any visual data on the globe. We can use pointer and images in the form of layers and PIPs and we can draw simple line segments. We need to implement the basic interactive features described in Section 3.1.

The first question to solve was the cursor. SOS offers the pointer (it was shortly outlined in Section 2.2.3). It can be moved, resized or replaced by the image, so it seems to be a perfect element. That is why the pointer and its control was implemented into the module. “Clicking” of the pointer can be ensured in dependence on user demand, e.g. in GUI or with the game pad. Because the pointer can be placed on the globe only once, we have to find other solution to implement multiple cursors. We have decided to implement multiple cursors as PIPs. It means that for each Wii Remote a new PIP is created and serves as a cursor on the globe, it can be moved or clicked. According to defined function we can set any reaction of SOS on the “cursor click”, we can define any button of the device to run any action of the SOS system. When the Wii Remote is reconnected, its PIP is removed.

SOS control module includes tool for connecting the Wii Remote gamepad. There are two modes which can be used. One Wii Remote can be used to control pointer of SOS. When we need more users (players), more Wii Remotes can be connected in PIP mode. This is the most important feature added into the system that enables interaction of the user.

The second interactive feature that should be added was the management of interesting places and areas. For the visualization on the globe we can choose from two techniques. To decide, we have to take into account two points of view – speed and exactness of mapping of the area border on the globe.

The first approach is based on the usage of the prepared images placed on sphere as layers. For each area we must prepare a separate image that must have the same size or at least the same aspect ration as the basic data image (or video). The border of the area will be rendered in a defined colour into the transparent background. We need to render each area in two colours – the active and inactive state, than, we can ensure the cursor area activation by changing the layers. In the second approach, we can draw directly on the globe with annotation commands. The colour would be updated according to the cursor position and the area repainted repetitively. If we need to change any detail, we have to redraw everything. Both alternatives have some positives and negatives which are summarized in Table 1.

Table 1: Positives and negatives of two basic SOS visualization tools – layers and annotation.

Layers	**Annotation**
POSITIVES	
exactness (if base and layer are the same in 2D, they are the same on globe)	if we create any new area, we can draw it without any data preparation immediately on the sphere
with one command can be shown, hidden or made semi-transparent in a simple way	
NEGATIVES	
sources must be saved on the SOS server in advance, everything must be prepared, nothing can be added real time	inexactness (although the coordinates of the points are computed from the same values, resolution of the sphere annotation is worse than of the base image (see Figure 5 on example of the Australia border)
it needs 1-2 seconds to load the area for the first time	
if the loaded area is missing, it is shown as the white non-transparent layer that covers everything under its position	in more detailed areas the border is visibly being drawn around the area
	have to be repainted each time we have to hide or show it

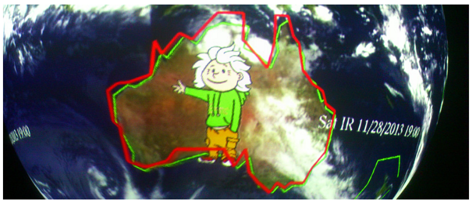


Figure 5: Demonstration of inexactness of annotation in comparison with the layer data. Green poly-line represents the original border and red inexact border is the result of annotation drawing.

As can be seen, there are many limitations of the SOS system. The big shared problem of both variants is the speed. Layer approach is independent on number of details of used borders, because each area has a separate image with rendered border. When drawing, we have to redraw each single line segment of the poly-line and so the usable number of areas depends closely on their level of detail. Usage of annotation gives inexact borders of areas and it needs to repaint all the time. We have tested the system for 40 areas (the maximal number of questions of the game). Finally, especially because of its exactness and also higher speed, it was decided to use layers for representation of areas borders. Layer approach with 40 layers (each used area has its own border rendered into separate image with resolution 4096×2047 pixels) works well.

3.2.2 SOS Commands Serialization

All commands going to the SOS system are processed serially. Some commands are single, but some commands (e.g. PIP modification) go in a sequence that should not be interrupted. If there are more sources of the commands processing, we have to keep the correct order. In principle, there is no problem, when any two single commands change their order, because if the sequence is interrupted by the command from another source, it could cause a wrong effect. For the better imagination we will present an example – processing of two PIPs. As mentioned in 2.2.4, each PIP (if we want to modify it repetitively) should have its unique name. For each modification we have to choose PIP we need to process (*pipselect name*) and then all commands concerning PIPs go to the selected one. Let us have two sources sending commands to SOS (S1 and S2). If the command sequences run independently (such as in the left column), PIP1 would have width 30 degrees and PIP2 50 degrees. But if the commands are serialized in a wrong way as in the right column, PIP1 would have width 50 and PIP2 remains unchanged.

S1: pipselect PIP1	*S2: pipselect PIP2*
S1: pipwidth 30	*S1: pipselect PIP1*
S2: pipselect PIP2	*S1: pipwidth 30*
S2: pipwidth 50	*S2: pipwidth 50*

From this reason all operations that should be done in a block have to be grouped into atomic blocks which are executed at once.

3.3 Model Implementation

The application should run on various operation systems – Unix (SOS server), Windows (touch screen, other connected PCs). The SOS system is administrated by the third site, so it does not enable many installations of any special software. That is why the programming language and Bluetooth library should be selected as platform independent generally used system. Several libraries were tested (BlueZ, 2014), (32Feet.NET, 2014), (Wireless Communication Library, 2014). Finally, we have selected Java 1.8 as the programming language and BlueCove 2.1.1 library for the Nintendo Wii Remote communication.

We have developed SOS control module that enables programmers to connect their application to a special projection and visualization system. Module serves as interface for controlling the SOS via user interface or any additive hardware added by the programmer. Moreover, it enables directly to connect Nintendo Wii Remote for user interaction. The module can be integrated into any Java application that needs to work with SOS. It offers a set of methods corresponding to the automation commands, providing telnet connection, commands transfer and processing.

The module is designed in a component way. Each feature described above has its program equivalent – e.g., PIP, Layer, or Pointer. They are supplied with object Telnet that ensures the telnet connection and enables to all classes to send automation commands directly to the SOS. Everything is covered with SOS object that ensures global commands and enables the other classes to use SOS.

Automation commands serialization is solved with synchronized java methods, where all the commands sending sequence are processed at once. The communication between the server and client application is solved with the Java sockets.

4 INTERACTIVE GAME

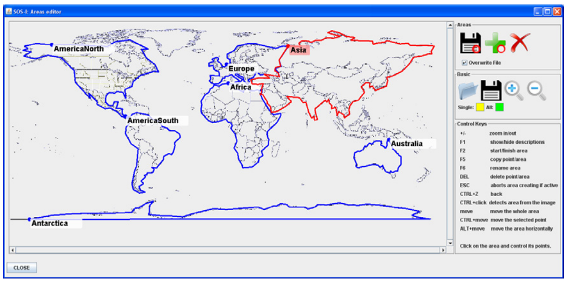
The implemented system of game works on a very simple principle. Let us start with a short motivation. We can imagine group of children sitting around the SOS globe and listening the edutainer speaking about the Earth, its continents and oceans. But how can we drag them into the education process or test what they remember? We can use the interactive game to increase their interest. We will divide children into several groups. From each group one child gets a gamepad controlling a cursor of a unique colour and learns to use it, to move the cursor and to click the action button. Now the game can start. Edutainer has a list of questions concerning the topic (e.g., “Select the continent with the highest mountain of the World.”). After the question is read, each group of children has to collaborate to agree on a correct answer. The fastest correct answer brings a point. Now, the edutainer can append an additional piece of information about the place and continues with the next question. Finally, the winner is a team with the highest score.

4.1 Game Application

The described concept was implemented into the Java application. The software is divided into four applications. Client and server applications are used for the game launch and two support tools, areas editor and game editor, are used for new game preparation. The whole game is built on the SOS interactive module that ensures the connection to the SOS system and commands sending and also connection of Wii Remote device.

Creation of a new game goes in several steps. Each game needs some data saved in several description and image files. First we have to determine the areas that will be active in the game. Because for various games the areas can repeat, it is recommended to create areas in logical groups (such as e.g. continents, oceans, states, …) and to save them in separate files. Later, areas can be combined according to requirements of the game. For the comfortable and precise data preparation the areas editor serves. This application can be used independently on the SOS and so data can be prepared on any computer. It enables to design and administrate particular areas in a 2D view. We can set their descriptions, borders and also render image layers. As the border colour any "neutral" colour should be used (it means colour different from colours of players), so that the number of used layer would not increase with every additional player. As the underlayer we can use directly the base image from the dataset. An important output from the application is the areas descriptions file and layer images. All these files have to be copied manually on the SOS server. In Figure 6, the areas editor with loaded description of continents can be seen.

When areas are prepared, as a next step, the game should be composed. Each game consists of at most 40 questions and each question has one correct answer. For the game creation, the second support application (game editor) was prepared. It enables to create and manage questions simply (as can be seen in Figure 7, the user has many tools for the game finalization). As well as the areas editor this application can be used on any computer independently on the SOS system. When the game is ready, the game description file is saved and it is transferred to the SOS server (together with the original area descriptions files).



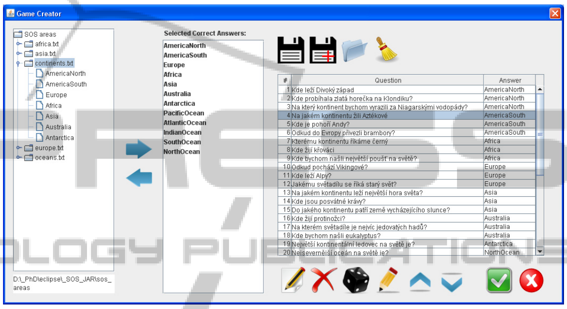
☑ Overwrite File

Control Keys

+/-	zoom in/out
F1	show/hide descriptions
F2	start/finish area
F5	copy point/area
F6	rename area
DEL	delete point/area
ESC	aborts area creating if active
CTRL+Z	back
CTRL+click	detects area from the image
move	move the whole area
CTRL+move	move the selected point
ALT+move	move the area horizontally

Click on the area and control its points.

Figure 6: Areas editor.



D:_PhD\eclipse_SOS_JAR\sos_areas

Selected Correct Answers:

AmericaNorth
AmericaSouth
Europe
Africa
Asia
Australia
Antarctica
PacificOcean
AtlanticOcean
IndianOcean
SouthOcean
NorthOcean

#	Question	Answer
1	Kde leží Divoký západ	AmericaNorth
2	Kde probíhala zlatá horečka na Klondiku?	AmericaNorth
3	Na který kontinent bychom vyrazili za Niagarskými vodopády?	AmericaNorth
4	Na jakém kontinentu žili Aztékové	AmericaSouth
5	Kde je pohoří Andy?	AmericaSouth
6	Odkud do Evropy přivezli brambory?	AmericaSouth
7	Kterému kontinentu říkáme černý	Africa
8	Kde žijí křováci	Africa
9	Kde bychom našli největší poušť na světě?	Africa
10	Odkud pochází Vikingové?	Europe
11	Kde leží Alpy?	Europe
12	Jakému světadílu se říká starý svět?	Europe
13	Na jakém kontinentu leží největší hora světa?	Asia
14	Kde jsou posvátné krávy?	Asia
15	Do jakého kontinentu patří země vycházejícího slunce?	Asia
16	Kde žijí protinožci?	Australia
17	Na kterém světadíle je nejvíc jedovatých hadů?	Australia
18	Kde bychom našli eukalyptus?	Australia
19	Největší kontinentální ledovec na světě je?	Antarctica
20	Nejseverněiší oceán na světě je?	NorthOcean

Figure 7: Game editor.

When the data is prepared and the description files and image layers are transferred on the SOS server computer, we need a system for the game launching. As it was mentioned before, we have decided to divide this function between two cooperating applications – server and client.

Server application should run on a computer connected into the same network as the SOS system. Moreover, the computer must be able to synchronize with the Wii Remotes and so it has to use the Bluetooth wireless technology standard. We can run the application directly on the SOS server (i.e., computer controlling the SOS). The application is very simple to use and, although it has a complex functionality hidden under the GUI, the user needs just to connect it to the SOS system and run the server.

After the server is started, it waits for tasks sent by the connected devices or clients. One or more clients and independently also several Wii Remotes can be connected to the server. Communication with the gamepad runs through the Bluetooth interface. Every Wii Remote can send demands on synchronization and later information about pressed buttons. The server reacts on them – moves the cursor, runs clicking actions etc. Connection between client and server is based on TCP connection and socket communication. There is a set of text messages ensuring the data interchange and actions providing (e.g., *GAME_START*, *WIIS_ADD, GAME_CLOSED*, *WII_ANSWER* and many others). If there is no task to solve, server application waits and does nothing. If there comes any message, server provides required action or sends the client required data.

The last part of the whole game system that is controlled directly by the user (edutainer) is the game client. After it is connected to the server application, it gets from the server list of available games. When the selected game is started, edutainer has a simple sequence of dialogs (each singular window contains a question and a correct answer) and can see what team of players has already answered and if the answer was correct. The last dialog shows results of the whole game. This application can run on any computer connected into the same network as the game server, the best is to run it directly on the touch screen of the SOS system. The edutainer can control the game directly from the globe neighbourhood and he/she does not have to keep any additional computer.

5 CONCLUSIONS

We have developed an interactivity module that was used as a base for the interactive game designed especially for groups of students and children. During the development we had to explore SOS features and possible ways how to affect the visualization. The whole module and connected application are created as an additional system that can be connected to Science on a Sphere system and extends the visualization system with an interactive element without direct intervention into the original equipment.

At this time the application has been already tested, new games are being prepared and ideas for further expansions and improvements are being collected. Presently we would like to implement two features, both of them are connected with the game areas preparation process. We plan to add functions for computing the game areas unions and we would like to create module for loading geographical data, so that the borders of states, continents or oceans could be more precise and their preparation less time consuming. The first function would enable to prepare automatically e.g. area of any continent simply as the union of all states in the continent. The second extension would enable to use geographical data (which are measured in various formats) to be loaded into the application and processed into the form of clickable areas.

We believe that there are many possible usage of the SOS interactive module. Except for the interactive game we have designed an application that is not oriented on the game system and that can be implemented in the future. It was designed as the tool for visualization of information about interesting places. The interactive application would give the user better control about what to see. By the gamepad it would be possible to choose one of predefined areas/places, click on them and ask the system to show prepared additional information e.g. in the form of audio or overlaid image.

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