Order description

The subject of this contract is the design, manufacture, delivery, assembly and commissioning of four robotic exhibits at the permanent exhibition at the Cogiteon Science Center in Małopolska.

The Exhibits must be designed and made in such a way as to be completely safe for the people using them, other people in the vicinity and the Employer's personnel performing service and maintenance activities. This condition also applies to foreseeable cases of using the elements of the stands by visitors contrary to the instructions or their intended use.
Electrically powered exhibits must meet all the requirements for electrical devices, in particular those intended for public use. It is recommended to use a DC voltage down to 120 V in dry conditions, 60 V in wet conditions and 30 V in wet conditions, and AC voltage down to 50 V in dry conditions, 25 V in wet conditions and 12 V in wet conditions in the first place. For control and protection circuits, safe voltage is a necessary requirement to be met. The voltage values are maximum values, the voltage values may be lower.
The exhibits must be durable and resistant to the actions of visitors, the estimated number of which will be approximately 3000 per day.

Computers used in the construction of exhibits must be adapted to work in continuous mode under full load, they should not overheat or reduce efficiency, which could cause the exhibit to be turned off.

The following description of the exhibits is appropriate for the tender documentation preparation stage. Details are subject to change in the final version of the bidding documents.

Exhibit 1

Working name of exhibit:
The Star Robot

Educational content:

I understand that there are different design solutions for the robot leg – less comparable (aluminum profiles) and more comparable (artificial muscles) to the actual structure of the human leg. I check what is the difference between the control of robotic legs using simple kinematics and inverse kinematics.

Description of the exhibit:

1. **What the exhibit is about and what it aims at?**

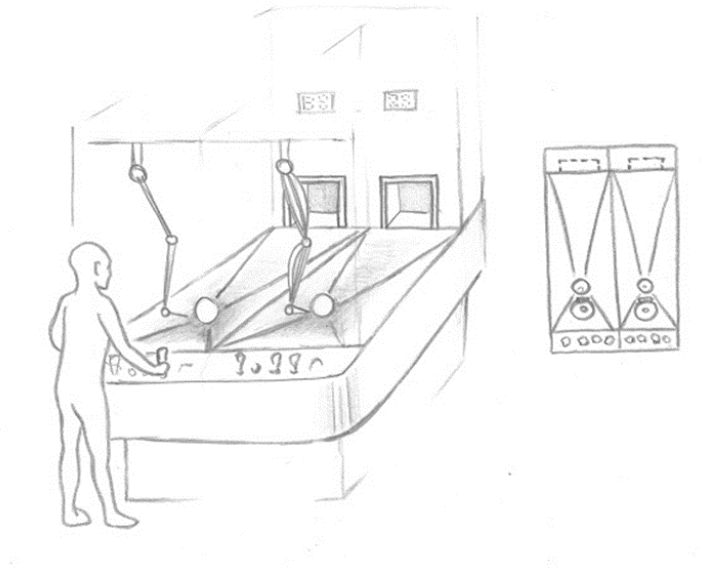
The exhibit simultaneously shows:

- two possible constructions of robotic legs: light and durable profiles with electric engines in the joints and based on a pneumatics (so-called) mechanism of artificial muscles

-and two different mechanisms for controlling the robot's legs - using simple kinematics and inverse kinematics.

Interaction with exhibit gives a chance to assess which solution is simpler or more intuitive to use. It also allows him to observe that while robotic solutions are inspired by nature, they are not an exact copy of them, because with current technology it is too complex and not always reliable.

2. illustrative drawing:



3. Description of the exhibit's elements:

- The free-standing exhibit, adapted for wheelchair users, consists of:
- two lanes ended with goals,
- two balls,
- two displays,
- two control panels,
- two robotic legs, one of which is electrically driven and the other is pneumatic,
- electronic system,
- pneumatic system.

3.1 Lanes:

- Adjacent to each other, set parallel, along the exhibit, separated by a partition preventing the ball from falling from one lane to another, made of durable, transparent material.
- The surface of each track (including the goal) is smooth and contoured in such a way that the ball always returns to the point directly in front of the robotic leg. It is located in relation to the robotic leg at a distance that allows the ball to be kicked. It is not possible for the ball to stop elsewhere.
- From the outside and from the top, the lanes are protected against falling of balls from the exhibit and against access by visitors. The side covers are made of transparent, impact-resistant, scratch-resistant and dirt-repellent material.
- The top cover is a permanent element, made of opaque material, resistant to impact, scratching and dirt. Its construction includes integrated elements of the lighting system, giving light with a color temperature in the range of 6000-8000K.
- The goals has sensors that confirm the hit and count the number of goals in during one game.
- After a goal is scored, the ball automatically returns to the designated place in front of the robotic leg.

3.2 Balls:

- Their weight and diameter are selected (at the prototyping stage) so that each of the mechanical legs can place the ball in the goal.
- The resilience of the balls is selected so that they do not bounce excessively after being kicked.

3.3 Displays:

- Two monochrome light displays placed above the goals to show the current result.
- The image is displayed as negative (light letters on a dark background).
- The displays design, technology, method of assembly and protection minimize the possibility of damage in case of a ball hitting and doesn't have any effect to the aesthetics and legibility of the image.

3.4 Robotic legs:

- Both robotic legs consist of the same main elements and have 4 joints: two hip joints - abduction, adduction and flexion, extension; one knee - bending, straightening; ankle - dorsal flexion and plantar flexion.
- The longitudinal elements connecting the individual joints and the foot are made of a rigid material with high mechanical durability.
- The preferred length of the legs after straightening is 800mm (+/- 20%). Their minimum height from the ground is 100mm.
- The elements of the first leg - electric, are moved by stepper motors located directly in the joints.
- The second leg - pneumatic, is moved by pairs of oppositely arranged pneumatic actuators, installed between individual joints and supplied with compressed air. Their setting is designed in such a way that filling one of the actuators of a given pair causes bending, and the other extends the leg fragment.

3.5 Control desks:

- Control desks, separate for each leg, are located on the narrower side of the exhibit, at the beginning of each lane.
- Their top is at a height of 800mm +/- 50mm. The undercut in the front part is at least 400mm.
- They are located in such a way that the user has the visibility of both the working robotic leg and the gate.
- Each console is equipped with 4 clearly described lever manipulators, controlling the following: vertical hip movement, horizontal hip movement, knee bend, ankle bend.
- The handles of the levers used to control the robotic legs are at a maximum height of 1100mm.
- In the case of an electrically powered leg, the deflection of the lever generates an electric signal for the driver of the stepper motor located at the given joint, with a forward or backward deflection angle.
- In the case of a pneumatic leg, the lever movement is responsible for controlling the pneumatic installation, supplying compressed air to individual pairs of actuators in such a way that its movement causes alternate tensioning and emptying of the actuators, and thus the movement of the controlled joint.
- Each leg can be controlled by simple kinematics and inverse kinematics.
- In the case of simple kinematics - we control each joint separately, in the case of inverse kinematics - we control the position of a given point (foot or knee).

3.6 Electronic system:

- It controls the mobility of the electric leg and ensures it returns to a neutral position after the interaction is completed.
- It is used to count scored goals and display the result on displays.
- Automatically resets exhibit after the time (set at the prototyping stage).

3.7Mechanism of artificial muscles

- It is a technical biomechanical solution that shows how human muscles work, while maintaining the functionality that allows for a dynamic kick of the ball.
- Selection of the type of technology for approval by the contracting authority.

4. Additional information:

The proposed display type is flip-dot.

5. Estimated dimensions of the exhibit:

Width: from 1800 to 2000mm
Depth: from 2000 to 2500mm
Height: max. 2500mm

Exhibit 2

Working name of exhibit:
Encoded
Educational content:

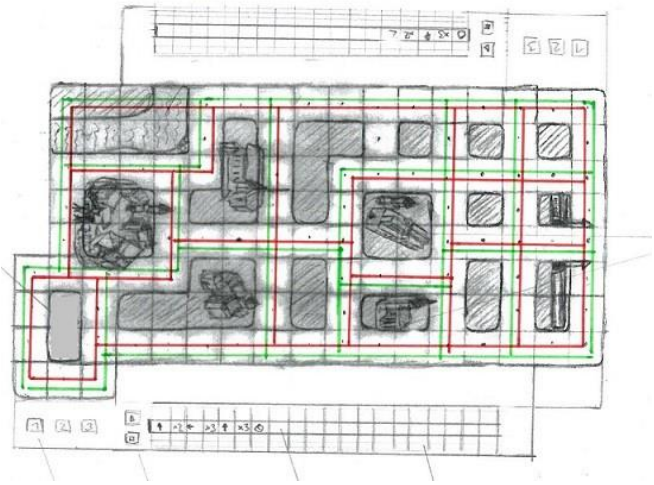
I will discover the basics of programming - I will learn that programming is giving simple instructions to a computer or a robot, which it follows in a specific order.

Description of the exhibit:

1. **What the exhibit is about and what it aims at:**

The visitor learns that programming is the transfer of simple instructions responsible for specific actions to the processor. Performing these tasks in the right order allows to control an external device.

2. **Illustrative drawing:**



3. **Description of the exhibit's elements:**

A free-standing, table-shaped exhibit on a rectangular plan, adapted for use by disabled people, wheelchair users. It consists of the following elements:

- Mock-up,
- Two robots,
- Two programming stations,
- Electronic system.
- Storage space for spare robots

3.1 Mock-up:

- The mock-up space is located in the central part of the exhibit, in a recess that covers most of the top surface.
- The mock-up presents a simplified plan of Old Krakow (narrowed down to the Planty and Wawel precincts and a fragment of the Vistula).
- Apart from the compact buildings, it also features recognizable buildings characteristic of Krakow.
- It is a plane on which robots programmed by users move.

- The robots move along routes marked on the mock-up. Their layout has been set so that only right angles are kept in the places of turning. The routes on which the robots: the "Lajkonik" and the "Wawel Dragon" can move are marked with two different colors.
- In addition, there are 2 starting points on the board, to which robots return when they detect an inactivity lasting more than e.g. 15 seconds (the exact time will be set at the prototyping stage), the robots return automatically
- The area of the mock-up has been clearly divided into 128 square fields (16 squares on the longer side and 8 squares on the shorter side) to facilitate programming the movement of robots
- There are inductive chargers at the starting points. The robots charge when the exhibit is not used.
- Each of the 128 mock-up fields was marked with a point located on the route line, contrasting in color with the rest of the route. These points are used by the internal software of the robots for orientation in the progress of the sequence of movements.
- From the top, the mock-up has been secured against access by visitors with a transparent plate. The distance between the transparent plate and the objects on the mock up is selected so as not to interfere with the mock-up elements and robots. The construction of the protection allows its easy disassembly by the exhibition staff for servicing.
- The mock-up is illuminated by a light source with a color temperature in the range of 6000-8000K. Lighting is an integral part of the exhibit.

3.2 Robots

- The exhibit is equipped with 6 self-propelled robots. 3 of them have the figure of a Lajkonik and the other 3 - Wawel dragon.
- A pair of robots participate in the interaction on the mock-up (Lajkonik and the Wawel Dragon) at the same time. The remaining robots are a reserve, stored in a clipboard built into the exhibit
- All robots have identical mechanical and electronic construction:
    - The design of the running gear allows the robot to rotate around its axis in place.
    - The capacity of the batteries enables the daily operation of one set of robots, assuming the attendance of 3000 visitors a day.
    - The robots have an automatic obstacle and collision avoidance mechanism. It is based on signals from proximity sensors mounted in the robots.
    - The electronic system of the robots is microprocessor controlled.
    - A real-time wireless data transmission system is used to communicate with the exhibit electronics, including transmitting information containing a user-selectable sequence of movements.
    - Charging robots inductively is possible at the starting points. A wired charger with a symmetrical USB Type-C plug is also used to charge the batteries installed in the robots. The chargers are in the clipboard.
    - The port used to charge the robots is also used to communicate with their electronics in order to make changes to the internal software.
    - The batteries installed in the robots are replaceable and made in a technology that minimizes the memory effect of cells.

- After resetting the exhibit, when it goes into standby mode, the robots automatically return to the starting positions marked on the mock-up surface.

3.3 Programming stations:

- Programming stations are located on the long sides of the mock-up.
- There are manipulators for arranging the sequence of commands executed by robots, as well as START, STOP and RESET / NEW TASK buttons.
- Each of the stations is responsible for controlling one robot, which is clearly marked with the character's graphics, as well as the color corresponding to the colors of the routes marked on the model on which a given character can move.
- There is also information about three tasks to be performed and serviced at the stand.
- Two-stage manipulators are provided for programming the robots, i.e. each manipulator consists of the first part, on which the user selects the command, and the second part, where the number

of repetitions of a given command is selected (the final number of manipulators will be determined at the prototyping stage, after testing the playability of the station).

- Above each of the drums there is a control with a light source that displays the RGB colors. It informs the user about the currently executed instruction:
  - Blue color: instructions followed,
  - green: instructions in progress,
  - orange: instructions pending,
  - red: error (executing an instruction inconsistent with the route - task to be performed)

- The manipulators are in the form of rotating, flattened drums, mounted on one axis of rotation, set horizontally and installed in the station in such a way that only a fragment of their side walls is visible.
- Each drum on the circumference has a set of individual commands in the form of pictograms to be performed by the robot (first stage of the manipulator): go forward; go backwards; ; turn right; turn left; end of sequence, empty field (causing waiting, e.g. 10s, the exact time will be specified at the prototyping stage) and the number of repetitions-fields to be moved - selection by numbers (second stage of the manipulator).
- The command is selected by rotating the first and second degree, i.e. a double drum. Repeating this action on subsequent keypads creates the sequence of events (program) to be executed.
- The robot starts its implementation after the visitor presses the START button. The STOP button is used to stop the running program, e.g. to change the sequence of actions.
- The RESET / NEW TASK button is responsible for the return of the robots to their starting positions after completing the task - covering the route designated by the user.

3.4 Electronic system:

- The exhibit has a built-in electronic system. He is responsible for:
  - Functioning of the exhibit - starting and automatic standby after detection lasting more than e.g. 15 seconds of inactivity (the exact time will be selected at the prototyping stage)
  - Support for lighting elements (board lighting)
  - Reading sequences of movements set by users using manipulators on control panels and sending them to robots
  - Implementation of commands given by the start and stop buttons located on control panels

3.5 Storage for spare robots:

- It is integrated with the exhibit enclosure, below the table top, in one of its side walls
- Only the exhibition staff has access to it
- It is used to store spare robots. Its size allows all six robots to be placed in it.
- There is a charger in it, which enables simultaneous charging of all the robots.
- The interior of the storage is illuminated when the door is opened.
- There is a USB Type-C plug in the glove box, used to communicate with the electronic system built into the exhibit

4. Additional information:

- The model should include such characteristic objects as: Barbican, St. Florian's Gate, St. Mary's Church, Cloth Hall, Town Hall, Jagiellonian University, Collegium Maius, Monastery and St. Francis of Assisi, Wawel.
- The tasks to be performed for the characters will be determined at the exhibit prototyping stage. They must be approved by purchaser
- Robot software must be developed in a standard and popular programming language. The contracting authority must accept the given development environment. The purchaser becomes the owner of the code after delivery of the exhibit and has full right to modify it.

5. Estimated dimensions of the exhibit:

The dimensions of the exhibit including the programming stations should depend on the technical and construction parameters of the robots. Overall dimensions must be in the range from 1600 to 1800mm x from 800 to 1000mm. The height of the exhibit allows visibility of mock-up the fields on which robot moves

Exhibit 3

Working name of exhibit:
Photobots

Educational content:

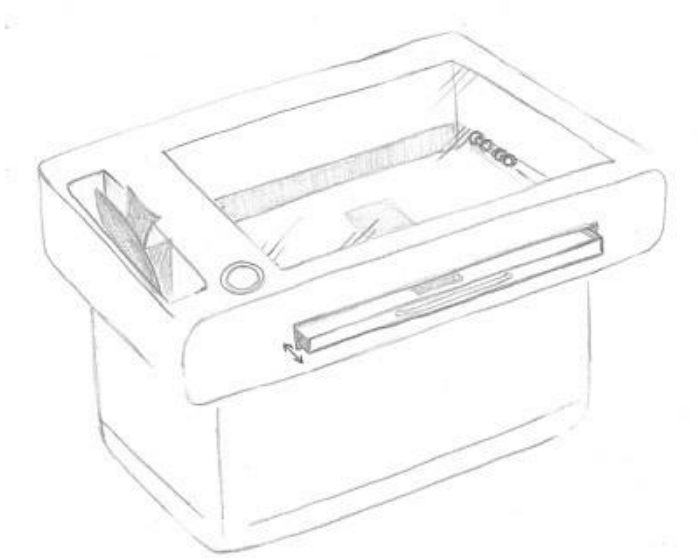
I understand that a light particle (photon) changes its speed (i.e. speed and direction) as it travels through the boundary of media.

Description of the exhibit:

1. **What the exhibit is about and what it aims at:**

Using a moving model, the exhibit shows how light quanta (photons) behave when crossing the boundaries of various media

2. **Illustrative drawing:**



3. **Description of the exhibit's elements:**

The free-standing, table-shaped exhibit is built on a rectangular plan and can be operated by people on wheelchairs. It shows how light quanta (photons) behave when passing through the boundary of different media, i.e. they change velocity with the direction of motion.

The exhibit consists of:

- Enclosure
- Movable elements that the user places on the photobot's pathway, and which simulate various light-permeable media
- Self-propelled robots called "photobots" - 3 pieces of identical look and design, 1 used in the interaction and the other 2 are reserve.

Enclosure:

- It is built on a rectangular plan, the longer side of which is in front of the User
- Its structure narrows below the top, which allows access for disabled people in wheelchairs
- It consists of the following key elements:

a. Cabinet:

- has a box structure
- from the top, its interior is inaccessible to visitors . Protected by the pane (made of transparent material
- at its bottom there is a plane on which the photobot moves
- below the plane there is an extendable working plane on which the user places the movable elements
-

b. The plane on which the photobot moves:

- It is made of a pane of transparent material, resistant to dirt and scratches
- It has a rectangular shape
- There are lines around the perimeter, the color of which is recognized by the photobot. These lines automatically guide the photobot to the starting point.
- At one of the shorter sides, the plane has a designated place where the photobot returns, and from which the interaction begins
- Its surface is illuminated by a light source (integrated with the exhibit) with a cold color temperature

c. Working plane:

- It is located under the cabinet
- It is used for arranging moving elements by the User
- It is extended beyond the edge of the exhibit
- Pulling out the plane activates the exhibit, and inserting it in activates the photobot
- Its surface has a neutral color
- The space under the plane is identical in color to its surface
- The distance of the working plane from the plane on which the photobot moves is selected so that after arranging the elements there is a small space above them
- The working plane has magnetic properties, which prevents the spontaneous displacement of the moving parts placed on it when it is moved in / out

d. Container for moving parts:

- It is integrated into the cabinet
- It has the form of a recess with a regular shape
- Its interior is lined with material to prevent damage of movable elements
- The movable elements are placed in the container in a vertical position

e. Clipboard for spare photobots:

- It is located under the cabinet
- It is only available to the exhibition staff
- Inside there is a device for charging photobot batteries
- The interior is illuminated. The backlight turns on when the clipboard is opened and turns off when it is closed

Movable parts:

- They are to simulate different light-permeable media of different densities (e.g. glass, water, oil, etc.)
- They have the form of flat plates with rounded edges
- They are made of flexible material

- Their surface is resistant to dirt and mechanical damage
- The color of the movable elements contrasts with the color of the working plane

Photobots

- Their movement is controlled by changing the color of the substrate
- They have a three-wheeled running gear
- Two of the wheels are placed on the axis and are driven by separate motors
- The design of the driving systems allows the photobots to rotate on the spot
- The wheels are made of a material that does not cause mechanical damage to the plane on which the photobot moves, and does not generate noise during its movement.
- Changing the speed (and thus the direction of travel) takes place by changing the speed of the drive wheel on the basis of the sensor collected (the sensor is located near both driving wheels)
- It occurs when one of the wheels recognizes the edge, i.e. the contact line of two different colors: the first one to be on the edge changes its speed (slows down or accelerates) the speed value depends on the color of the ground corresponding to a given medium.
- The radii of the turns correspond (in model terms) to the values of the refractive index in various media and are consistent with Snell's law
- Driving over the working plane is read by the photobot's control software as driving straight ahead with a fixed, constant, reference speed.
- After recognizing the return line at the edge of the plane on which the photobot moves, it automatically follows its trail to the starting point. After reaching the starting point, it automatically rotates towards the plane.
- The capacity of the battery enables all-day work, and the charging time does not exceed 8 hours.
- Batteries used in photobots are replaceable

4. **Additional information:**

- Robot software must be developed in a standard and popular programming language.
- The contracting authority must accept the given development environment.
- The software must anticipate a situation in which the return line at the edge of the plane on which the photobot moves will be obscured by the user with a moving element. In this case, the robot should be able to automatically return to the starting point.

5. **Estimated dimensions of the exhibit:**

Width: max. 2000mm
Length: max. 2000mm
Height: max. 2500mm

Exhibit 4

Working name of exhibit:
Mars mission
Educational content:

Developing strategic skills, teamwork and a sense of collective responsibility through a strategy game simulating the colonization of Mars.

Description of the exhibit:

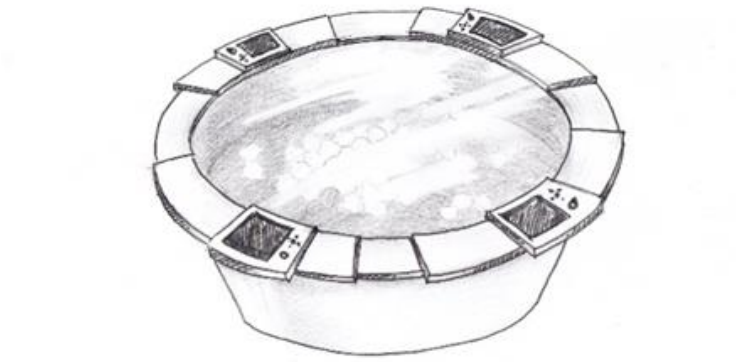
1. **What the exhibit is about and what it aims at:**

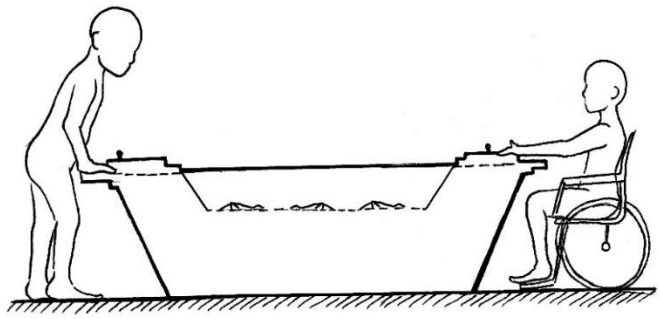
The aim of the exhibit is to make visitors aware of the complexity of the problem of colonizing another planet on the example of an attempt to colonize Mars. Interaction shows the differences in the effectiveness of teamwork and alone. The conditions on Mars are unfavorable for people, most of the necessary things (especially at the beginning

of the base's existence) will come from Earth. Performing even the simplest activities is difficult due to the topography and limited resources available to the settlers. Therefore, future Martians will be forced to cooperate so as to make the best use of the equipment, time and resources at their disposal.

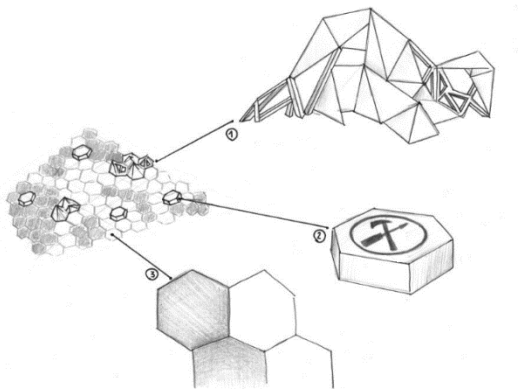
2. Illustrative drawing:

2.1 Display





2.3 The board



1 - terrain - hills built on the plan of one or more connected hexagons, white, geometric form;

2 - task stations - fields with task markings protruding above the board level, in the shape of a regular hexagon, illuminated, with a clearly marked icon of a given task;

3 - luminous panels - a component of the board field, hexagonal shape;

3. Description of the exhibit's elements:

Table display, free-standing, circular, adapted to be operated by people in wheelchairs. It consists of the following elements:

- The board - models of the Martian base
- Set of robots - rovers - 2 sets of 4 pieces, including 1 reserve set
- Controllers (4 pieces)
- Electronic system
- Storage space for spare robots

a. Board - Mockup of Martian base

- The board is round, which allows all users to observe the situation
- It is located in the rece of the counter top. The board from the top is secured with a transparent plate, with the possibility of its disassembly by the exhibition staff, for service purposes. For example, robot exchanges.
- The part of the table top around the recess with the board forms a frame in which the controllers are mounted. Its width and strength allow the user to lean back comfortably.
- The board features a model of the Martian base and the surrounding area, simplified to simple geometric forms (the spatial layout of the model will be determined at the prototyping stage).
- Objects on the model and the board surface are monochrome - white. The surface on which the robots move - the rovers - is made of a translucent, milky material.
- The board has been divided into hexagonal fields (their number and size will be determined at the prototyping stage).
- The most important object on the model is the main base, represented by several hexagons in the central part of the board.
- The fields on which robots can move (rovers) are flat and illuminated from the bottom are illuminated. The color of the light is cold. The light intensity and the way the board fields are illuminated depends on the interaction mechanics and is controlled by the electronic system.
- In several fields - task stations (designated at the prototyping stage) that protrude above the board level, there are pictograms indicating tasks to be performed (e.g. transport of raw materials, sampling, etc.). Pictograms are placed on the upper wall of the pedestals. When the users select tasks from the list, the pictograms on the task stations light up in the color specified for a given user.
- Task stations are equipped with sensors that detect the presence of the robot.
- The fields inaccessible to robots are an imitation of hills. They have the form of geometric solids (graphic reference). The terrain fields are not illuminated, so the rovers cannot drive into them. Within the fields marked as the main base, there is an induction charger invisible from above, which automatically recharges the rover's batteries after they return to the starting point.
- The fields within the main base have occupancy detectors that detect the presence of robots.

b. Controllers

- The exhibit is equipped with 4 identical controllers - control desks, placed around its perimeter, at equal intervals. Each controller is responsible for controlling only one robot
- Each controller consists of: a touch screen and an analog directional manipulator (its form: buttons or an industrial manipulator to be determined at the prototyping stage)
- The controller screen displays an interface that includes:
- color marking of the station and the rover,
- task panel (with information: completed, in progress, free) with color coding corresponding to the players,
- fuel condition in the rover,

- simulation of the view from the rover's front camera - a view of the Martian environment with superimposed elements (bases, task stations, hills) in the places corresponding to the model. The board and elements visible in the animation are arranged as real.
- navigation instructions - messages, icons and descriptions of activities.
- controller screens are placed at an angle to the user

c. Set of robots

- The appearance and design solutions of the rover robots visually refer to the vehicles used by NASA in Mars missions. Each robot is equipped with:
  - A slow-moving, remote-controlled driveline
  - Internal electronic circuit
  - A set of proximity sensors
  - Sensors recognizing the illumination of the board fields and its intensity (you can only move on the highlighted fields, and only move back from the dimmed ones towards the highlighted fields)
- The number of rovers depends on the number of playing positions: 4. Each of them is marked with a separate color, identical to the corresponding controller.
- The rovers are wirelessly controlled in a technology that ensures the smallest delay between the command being given by the directional manipulator and the robot's response. The technology used enables intuitive and effective robot control.
- The rovers are equipped with a battery power system. The capacity of the cells has been selected so that they are sufficient for all-day use of the station, without the need to replace the robots or recharge them with an external charger during the day.
- The robots' batteries can be charged inductively or after the Center's working day is over, using a classic charger located in a compartment accessible only to the exhibition staff.
- After the exhibit is reset, the robots return to the main base on their own, where the process of their automatic inductive charging begins

d. Electronic circuit

- It consists of a computer (integrated with the exhibit) that controls the course of interaction and electronic systems in the rovers
- The internal software and electronic systems of robots are responsible for:
  - Automatic return to the home base area after a station reset
  - Recognition of illumination of board fields.
  - Recognition of commands issued by controllers
  - It prevents entry into unlit fields
  - Collision prevention based on data from proximity sensors.
  - Communication and data exchange with the electronic system of the exhibit.
- The electronic system built into the station is responsible for:
  - Displaying the image on touch screens installed in the controllers
  - Control of the course of interaction
  - Recognizing commands issued by controllers and transmitting them to robots
  - Interpretation of signals received from robots and on their basis assessment of the status of tasks performed by users of the exhibit
  - Illuminating the board fields in an appropriate way, adequately to the tasks performed by the users, as well as in accordance with the current situation during the interaction
  - Automatic and forced (available for exhibition staff) exhibit reset
  - Recognition of the current position of the robots on the board
  - Inductive charging of robots at the home base

e. Storage space for spare robots

- Its dimensions allow for safe storage of 4 spare robots, which are equipped with the exhibit.
- It has a built-in impulse charger that allows you to replenish the energy supply in 4 rovers at the same time.
- The locker is available only for the exhibition staff.

4. Visitor experience:

The exhibit is designed for interaction of 1 to 4 people at the same time.

- The task of the participants is to reveal (i.e. illuminate) the entire surface of the board by performing tasks consisting in leading robots-rovers controlled by them between the main base and task stations.
- While performing tasks, users have to constantly monitor the fuel level in the rovers they control, because its lack means a failure and automatically ends the game.
- Fuel is a conventional unit that does not reflect the actual battery charge level in robots.
- The game emphasizes the need for cooperation between settlers and a limited amount of resources (fuel). It does not focus on a settlement's consumption of goods.
- Joining other participants to the game is possible at any time, if one of the controllers is free. New players can continue their predecessor's quest or choose a new one if the previous quest has expired.
- The tasks expire automatically after the exhibit software detects, for example, 10 seconds inactivity (the exact time will be determined at the prototyping stage). After this time, the controller screen returns to its initial state (START MISSION), and the task returns to the tasks pool.
- The game works in a turn-based system. Its maximum length is 3 turns, each has 4 tasks to complete (12 tasks in total for one game).
- A turn ends when all its tasks are completed. After its completion, the next part of the map lights up and users again select tasks for the next turn.
- The amount of fuel is the same for each turn, which increases the difficulty level as the game progresses.
- The fuel supply is calculated in such a way that for the last turn, it is possible to complete the task with a minimum number of corrections to the robot's route.
- Both controllers and rovers are not assigned to specific tasks - their selection is made by the participants each turn.

4.1 Gameplay

- Initially, the board is dimmed and the following message is displayed on the controllers' screens in the form of a touch button: "Start the mission".
- After pressing it, the station starts, the base fields in the central part of the model are highlighted, and the list of tasks to be performed appears on the screen, allowing for their selection and booking.
- The number of tasks in each turn is equal to the number of controllers and the maximum number of players - 4. Examples of tasks are:
    - obtaining resources and delivering them to the main base, two variants of resources - the resource icon displayed in a given part of the model,
    - sampling at the station outside the base - microscope icon,
    - repair of station elements outside the base - hammer and screwdriver icon.
- After making the selection, the detailed description of the mission appears on the controller's screen, and on the model (in the field symbolizing the station of the selected task), the graphic designation of the station is highlighted in the color corresponding to the given player (e.g. a microscope pictogram).
- To complete the task, the player uses the analog manipulator on the controller to steer the robot and lead it to the task station.
- When the robot reaches its destination, it is detected by proximity sensors. A task completion message that requires user approval is displayed on the controller screen. After validation, the illuminated pictogram at the task station expires.
- Two-stage tasks (going to the station and returning to the base) require double acceptance on the screen, eg SAMPLING AND DELIVERY OF SAMPLES TO THE BASE.
- The next round begins when the controllers confirm the completion of all four tasks. Its beginning is signaled by the automatic lighting of the next part of the board. Then the participants choose 4 more tasks.

4.2 Additional Rules

- After the turn is over, the rovers remain where they finished their tasks.

- If the player runs out of fuel in the rover during a turn, the controller's functions are blocked and the following message appears on the screen: "No fuel". Thus, the rover remains blocked. The failed quest enters the pool of quests to choose from.
- If there are fewer than 4 players in the game, the user can switch to a different controller to continue playing with a different rover.
- Unlocking a blocked controller and a rover that has run out of fuel occurs automatically with the successful completion of all tasks for a given turn of the game.
- If there is more than one player in the game and the player completes the tasks he chooses for the turn before using all the fuel, his rover remains inactive until the other players complete their tasks
- Automatic reset of the entire exhibit takes place in the case of:
    - Completion by participants of a set of 12 tasks for 3 rounds of the game and victory (the message about the victory is displayed on the controllers' screens),
    - lack of fuel in all rovers (message on the controllers about the lack of fuel)
    - no signal from all controllers for a time longer than e.g. 20 seconds (the exact time will be determined at the prototyping stage)

5. Additional information:

- the exhibit is equipped with an additional, hidden reset button, available only for the exhibition staff

- The color markings on the rovers are clearly visible.

- The exhibit is accessible to people in wheelchairs - a table top at a height in the range of 750-800 mm from the floor, with an indentation of a minimum depth of 400 mm.

6. Estimated dimensions of the exhibit:

Table with a diameter of 2500 mm and a height of 750 mm