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Board game for children with visual disabilities.

"Exploring Europe"

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FINAL TESIS BACHELOR

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1. Targets

The main objective of this project is the development of a board game adapted to children between 8 and 12 years old with different types of visual disability. This board game is about two Europe maps, one political and one physical, where each country is highlighted. With this it is intended that children learn about general culture while they entertain and have fun.

The most important geographical features of each country, such as rivers, mountain ranges, etc., have been manufactured using 3D printing. Users through touch are able to relate each geographical feature to their respective country. To finish it rules will be imposed. All this it will be designed so that the environmental impact is the minimum.

This didactic board game can be used both in the domestic sphere and in classrooms of specialized schools, which would be the greatest and achievable.

2. The game

2.1. Definition

Game (Oxford dictionary): Recreational exercise subject to rules, and in which it is won or lost.

Toy (Oxford dictionary): An object for a child to play with, typically a model or miniature replica of something.

A toy is an object intended for entertainment, both children and adults, as domestic animals such as dogs and cats. Toys can be used individually or with others. The themes of these depends on the historical period, the culture, the age at which they are directed, although some enjoy universal popularity.

Since they exist, toys for boys and girls are usually distinguished by their references that reflect their adult life, typically female tasks, such as parenting; Children's toys include action items: weapons, cars, horses. Even differentiated by colors, the same play if it is intended for children is blue and if it is intended for girls is pink.

Although at the present time it is progressing, and this is changing, it is very important to foster critical judgment regarding consumption and sexist use of games and toys.

Other objectives of these are to develop creativity, and cooperation while playing, to learn to socialize and relate while having fun, and also have to give important value to learn to take care of their own toys and that of other children.

2.2. Classification

According to the age group to which they are addressed, we can differentiate:

- **Toys for babies:** Generally, without gender differences. Most help them develop their motor skills, such as learning to crawl or walk.

- **Toys for children:** for children who are not babies and until adolescence, and although this should change, they are classified as toys for children, for girls and for both.

- **Toys for all ages:** They usually exclude babies, but they serve all ages and are excellent for multi-generational cohabitation, as is the case with the family coexistence.

- **Toys for adults:** exclusively for adults, they are usually sexual

They can also be classified according to the capacity they develop in children:

- **Intelligence:**

  - Board games: chess, backgammon, ladies.
  - Card games: families, couples, cards,etc.
  - Identification and memorization games

- **Affectivity:** These are toys with a soft touch, harmony of colors or sounds; such is the case of stuffed animals, rag dolls, etc.

- **Sociability:** These are games that imitate scenes typical of adult activity.
  - Kitchen, iron, doll cars, other housework.
  - Musical instruments.
  - Communication games.

- **Fine motor skills:** Helps to develop the skill of the hands.
  - Parts constructions.
  - Games to paint and draw.
  - Toys to fit.
  - Puzzles and puzzles.

- **Global motor skills:**
  - Small vehicles: strollers, bicycles, tricycles.
  - Balls, foosballs, skates.

2.3. Toy task

The toy has multiple functions, such as training, learning, development or stimulation of the intellectual, psychological, sensory-motor and social coexistence aspects, among others. But the most important objective of this is recreation. It is in children that the toy becomes essential and in which it takes its maximum value in the context of human development. Both the physical and the psychological. It is through the toy that children explore, discover, learn and interact with multiple objects and problems that are a part important of your development as individuals.

Since they are aimed at children, there are a number of conditions to take into account when making such toys:

- Toys must be made with non-toxic materials.
- Depending on the age, the size of the toy should not be less than the diameter of the trachea.
- They should not have sharp edges, spikes.
- Avoid cavities that may cause entrapment or injury.

For all this, after the manufacturing process the toys go through a quality control to ensure that they comply with the established considerations.

Thanks to the game the integration in the family and society is achieved, it is a preparation for adult life, in which everyone has to participate, since the child will need some guidance to play. The child sees what is happening around him and tries to imitate him. Blind children are deprived of this possibility. Naturally, their games are mostly auditory, although there is also touch, because they lack visual stimuli. That is why they will need more help.

Throughout the history of this branch of special education, teachers of the blind have developed a wide variety of games and toys. It has been shown that almost all games

for children with sight are fit the blind. Blind children can handle a variety of everyday tools such as scissors, thread, etc.

All children, even the blind, develop their games through action.

2.4.   Toys for blind children

Children develop through the game. The different types of games can help the development of a series of skills. Children who are blind or partially sighted people may have to work harder to use their visual skills, and this can become exhausting. Also, they are more dependent on their touch and listening; skills that they develop as they grow and learn.

The exploratory game encourages the use of motor skills, stimulates the senses of touch, hearing and vision, and introduces cause and effect. Extends children's interest in their environment and encourages them to make sense of the world around them by being curious, experiencing and making connections.

The imaginary game allows children to represent roles and situations that are familiar and not familiar to them. They can practice daily routines such as shopping, cooking, exploring and fancy-dress ideas. Children need experiences of real things before understanding 'toy' versions.

The construction games and the creative ones allow your child to express their thoughts, ideas, feelings and develop an understanding of different objects, materials and tools and this can be through arts and crafts, movement and dance, sound and music, build things and separate them.

Puzzle-type games and puzzles provide challenges and encourage problem solving. These games and toys give children the opportunity to ask questions, understand the rules set by others, and share the collaborative game with a larger group of children and for longer periods.

Physical play gives children opportunities to develop body control and coordination of large movements, manipulative skills, spatial awareness and balance. Children need toys, indoors and outdoors, to be active and develop confidence in their movements.

Outdoor play in cut grass, leaves, mud, water, snow or sand contribute to a varied and enriching sensory experience. Play in outdoor spaces can encourage circulation and mobility.

With everyday items we can extend an experience to the child of the real world through the game. Make a Treasure Chest using a sturdy, shallow basket, containing a collection of elements of daily life; could include a lot of keys, teddy bear, paper, ribbons, a blender, a wooden eggcup or a lemon; Items varied in weight, size, texture, color, taste, temperature and sound. The objects must be washable, disposable or replaceable. Children will use all their senses to discover what an object is, and what it can do.

It is also very important to create a play environment where the child feels comfortable, that's why you should:

- Ensure that the child is in the most appropriate position to use their hands and eyes in the best way, whether seated, standing or lying down.
- Define the play space close to the child or to create a "safe zone" or ensure that an adult play with the child.
- Keep the toys in easy access or put the toys on a tabletop tray or shallow box.
- If toys can roll out of reach, try to get the child to find and grasp the toy, this will develop in the small search and mobility skills.
- Use a simple, short and descriptive language in what refers to what the child is doing or their behavior.
- The child needs game partners, spaces, materials and toys for the game.
- Encourage children to try new things, to feel confident about the challenges of the future and to develop with them a great attitude for learning.

2.4.1. Games for the development of sensory capacity

There are specific toys designed to train the ear or touch. Therefore, it is possible to stimulate, develop and sharpen the sensory capacity of the child.

It is necessary to teach the child all possible objects and what happens when you manipulate it one way or another. In this way he learns that certain sounds and noises are only heard when performing the action correspondent. We must encourage the child to pick up or touch things, because the more stimuli they collect, the better for their development.

If we cover the eyes of children who can see, touching becomes a game full of emotion. Through distractions of this kind the children they develop a greater understanding towards their blind friend.

Construction games exercise dexterity and sense of touch.

There are cd's that contain only sounds, sounds of nature such as from the sea, birds, waterfalls, tempest, crickets, etc., classical music: Bach's works, and the well-known "Mozart effect" for develop creativity and emotional intelligence.

Pasty paints adhere very well and once dried they allow easy recognition of contours. Strong colors influence the visual rest and for that reason it is convenient that the toys and all the objects used by the child with visual impairment, have a clear color and sufficient contrast.

Order and classify things is a fun game.

The recognition of forms can be exercised very well with games of assembly. The adult helps the child understand what he has to do and how can you solve the problem.

2.4.2. Games for the development of social communication

In principle it is necessary to teach the child toys, a doll, ware and the clothes. Your satisfaction should be shown at all times when using the child's toys. It is necessary to mention the colors.

The person who is present seeks that the various actions have the proper coherence. It will guide the child's hand if necessary and will correct the movements. When the child is able to perform various actions with independence in the game, there is the possibility of giving them a global meaning.

The games of doctors, shopkeepers, or trips serve to develop knowledge and observation skills. The child's imagination can be further stimulated by employing substitute elements, for example, buttons instead of coins for pay the tickets.

2.4.3. Games aimed at the objective perception of the child's environment

It is necessary that the blind child has notions of the variety of things that surround you in the different media in which you move. The game does make this learning phase easier and more enjoyable for you.

It is convenient that the housework games are applied equally and without exception both children and girls, as they will learn to cook, clean, order, etc. Which will provide them with a certain level of independence, an important objective for which we have to work.

Taking into account the great importance of traffic, the child has to be educated as soon as possible in clear concepts about means of transport and to become familiar with its most important elements through the game.

In the game, concepts about traffic are reinforced. Cars have their own place to pass and people also have theirs: the sidewalk. That is why it is so recommended that the child plays the means of transport.

Playing with play dough is very good to develop the coordination of hands and dexterity, concepts are formed and fantasy is stimulated.

Another interesting activity is for the child to cut pieces of small colored paper, with round-tipped scissors, or other type identify him by touch. Then they stick to a grid sheet.

When carrying out these operations, he becomes familiar with the material he uses and uses his visual rest, if he has one, and learns to work with cleanliness.

2.5. Market research

The objective is to know which toys are being sold and which they are the tendencies; For this purpose, a study of market to analyze the existing products in the toy sector accessible and competition. Most accessible toys are manufactured abroad, being able to be acquired via internet. The selection of toys has been made based on criteria of innovation, materials, aesthetics and accessibility.

Investigating in Spanish toy stores located in cities such as Barcelona, Valencia, Alicante and in shopping centers: Dondino, imaginarium, poly toy store, teddy bear, etc., in these establishments there are no toys adapted for children with visual disabilities; However, three-dimensional figures were detected such as: numbers, fruits, animals, balls, toys with sounds, color, shape, relief, etc., which could be given an application for the aforementioned users.

In the Abacus cooperative, also Spanish, in catalogs prior to 2015, included toys for children with disabilities, currently due to the crisis and not being sold such toys, the entity has discontinued, and can only be purchased if they are in stock.

We have also found some toys adapted in the company HOPTOYS, and they are the following:

ABECEDARIO TÁCTIL

PERRO GUÍA Y ACCESORIOS

UNO BRAILLE

But what has been appreciated after doing this research is that of the few adapted toys that we have found in the market most are suitable for young children, once they grow and need to learn more knowledge they will not have these resources.

That is why our product will have few competitors and will be very useful, since it is suitable for children between 8 and 12 years old, therefore we can expect it to be well received in the market.

An important pillar in this market study and in general in this project has been the ONCE, National Organization of Blind Spaniards. The ONCE is a public corporation of non-profit social nature that has the fundamental purpose of improving the quality of life of the blind, visually impaired and disabled throughout Spain.

It has 72 256 members, of which 80% are people with severe visual impairment and 20% are people with total blindness.

It is a very active organization that participates in the various national and international forums on blindness and disability, also promoting different initiatives to achieve its function. He is a founding member of the Spanish Committee of Representatives of People with Disabilities.

It has recognized a state concession in terms of gambling for the sale of lotteries, which allow it to finance its social work and create jobs for its members.

According to interviews conducted by the pedagogues of the ONCE, in Valencia, they commented on how children learn and the different degrees of visual disability, Braille system, applications, Android app and tablets, etc.

Visiting his website, we can see the toys they use and in his store we find the Tiflotécnico catalog, where we can read the techniques, knowledge and resources aimed at providing the blind and visually impaired the appropriate means for the correct use of technology in order to favor their personal autonomy and full social, labor and educational integration. In this catalog we can see a type of map of Europe from which we will take ideas to design our own and their respective guides of use.

3. Europe map design

3.1. Functional attributes

3.1.1. Processes

- Programs for image capture, graphic design, and 3D for the numerical control milling machine.
- Plotter for printing of screen printing in visual characters on sheets of flexible PVC of 200 microns. Numerical control milling machine for the preparation of the original master that contains the relief and braille, made on a resin plate.
- Thermoform for heat printing copies on PVC sheets previously screenprinted.

3.1.2. Materials

The material chosen for the matrices is that of flat plates produced based on thermosetting resins, homogenously reinforced with fiber of cellulose and manufactured at high pressure and temperature, through the use of a numerical control milling machine

that uses a 3D program. The material chosen for the copies was thermoformed into sheets of flexible PVC that had previously been screen-printed.

3.1.3. Internal and external stresses

The material that should be used to produce the matrices should be sufficiently rigid and stable to withstand sudden changes in temperature without cracking or splintering, and so that it can be subjected to manipulation and machining processes (milling and heating processes by multi-thermoforming). These materials include, among others, resins, rigid PVC, metal and methacrylate.

As for the characteristics that the material must gather more suitable for making the copies of each map, I list the following:

- Resistance
- Flexibility
- Durability
- Be pleasant to the touch
- Accept silkscreen well
- Be premeable to thermoforming

3.2. Formal features

3.2.1. Projection and scale

In order to design geography maps for blind and visually impaired people, the concepts of projection and scale must be relativized, since we need great detail in a very small space.

For the maps of this collection a projection has been used conical that has had to modify as a result of the meager dimensions of some of the elements that must be represented, and that, given their very small dimensions, to be able to be perceived tactilely they must be enlarged. In addition, on continental political maps the inclusion of Braille codes or abbreviations within countries whose extension is very small often requires the retouching of borders, extending them artificially.

3.2.2. Relief design

Tactile maps for people with visual disabilities are structured in different levels of height or levels: seas, countries, rivers, borders, mountain ranges, state capitals, cities with more than one million inhabitants, etc. This need determines the use of different relief forms, such as: dotted lines, continuous lines, points with a rounded or square shape, granulated or fluted textures, or masses with different height gradations.

3.2.3. The colour

In order that tactile maps can be used in standardized environments - that is, jointly by people with and without visual impairment, whether in educational or playful environments - it is necessary to use different colors to represent different areas, countries or geographical areas.

The fundamental aspects that have been taken into account have been the use of a reduced number of colors (up to a maximum of eight), that these were clearly distinguishable visually by people with low vision, and that between them had a high contrast. For the continental political maps, the following were chosen:

3.2.3.1.   The macrocharacters

Taking into account that the population of people with disabilities visual, which has a usable visual rest each time represents a percentage higher than that represented by blind people, It was considered necessary that all the labeling of the maps in visual characters was written using larger fonts than usual. In Consequently, three different sizes of sources have been used: from 24 up to 36 points, depending on the physical space available and the geographic elements to represent. In addition, the use of non-serif fonts, for example, Arial or Verdana.
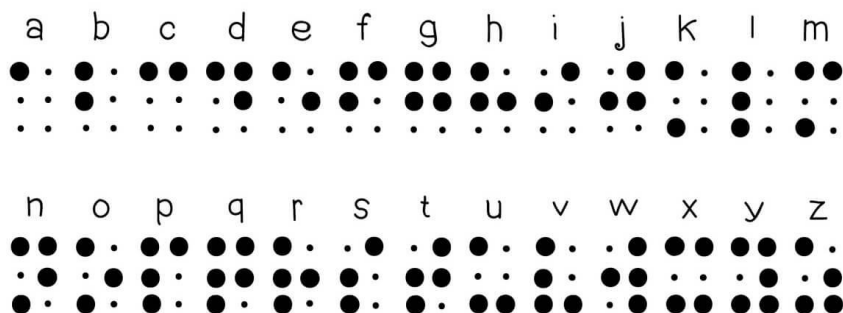
4. Monuments to scale

4.1. Functional atributes

4.1.1. Processes

Die-casting molds for plastic or metal, will be manufactured using 3D technology or artisanal sculptor.

4.1.2. Materials

Material of plastic figures PVC, ABS, PLA.

4.1.3. Internal and external stresses

They support blows, falls and should not break when being manipulated by the users.

4.2. Formal features

- Size between 4-7,5 cm depending on the model.
- Difference of colors (do not apply gray colors and maximum 8 colours).
- Texture according to form, but defined to be sufficiently recognizable. Geometry is defined by the monument it represents.

5. Factor to consider

5.1. Regulation UNE-EN 71:

5.1.1. UNE-EN 71-1: 2012 + A3: 2014 Safety of toys.

- **PART 1: Mechanical and physical properties:** This part refers to the type of material used, its assembly, its geometry, safety, stability, resistance, acoustics and many other factors.
  This European standard specifies the requirements and test methods for the mechanical and physical properties of toys. It applies to toys for children,

means toy any product or material intended to be used for purposes of play by children under the age of 14 years. It includes specific requirements for toys intended for under 36 months and for very young children who can not stand erect without help.

It also specifies the requirements regarding packaging, marking and labeling.

- **PART 2: Flammability:** This European standard specifies the categories of materials flammable substances prohibited in all toys,

and the requirements relating to the flammability of certain toys when they are submits to a small source of ignition.

Test methods are carried out to determine the flammability of toys in particular conditions.

- **PART 3: Migration of certain elements:** This standard specifies the maximum acceptable levels and the methods of sampling and extraction before the analysis of the migration of the elements antimony, arsenic, barium, cadmium, chromium, lead, mercury and selenium from the materials of the toys and their parts. Packaging materials are not included, except that are part of the toy or are endowed with a playful value.

The requirements are related to migration from the materials of the following toys:

- Paint coatings, varnishes, lacquers, inks printing, polymers and coatings.
- Polymers and similar substances, including laminated, whether reinforced textiles or not, with of other textiles.
- Paper and paperboard.
- Natural or synthetic textiles.

- **PART 6: Graphical symbol for age warning labelling:** This European Standard specifies the requirements for using and designing of a graphic symbol for labeling warning about age in non-convenient toys for children 3 years old. This symbol is intended to inform adults that the toy can be dangerous for children under 3 years of age. The indication of specific risks should appear about the toy, its packaging or the instructions for use. The elements of the symbol must be:

- The circle and stroke must be red.
- The background must be white.

- The indication of the age range and the contour of the face must be black.
- The symbol must have a diameter of at least 10 mm and the proportions between its different elements must be as indicated in this regulation.
- The age range for which the toy is not suitable has to be expressed in years, that is: 0-3.

- **PART 10: Organic chemical components. Preparation and extraction of samples:** This part should be read in conjunction with the EN Standard 71-9, which contains the requirements for certain compounds in toys, and Standard EN 71-11, which specifies the methods of analysis.

This European standard takes into account the opinion of the Toxicological Section of the Advisory Committee published in 1992 (EUR 13976) which recommended that certain groups of chemical compounds used in toys and toy materials would need special attention.

In drafting this document, the Committee Technician CEN / TC 52, has considered that the compounds organic can be classified within the following groups:

- Solvents.
- Preservatives.
- Plasticizers (excluding phthalate plasticizers). (1)
- Flame retardants.
- Pressure gauges.
- Biocides (preservatives of wood).
- Processing aids.
- Coloring agents.

- **PART 13: Olfactory table games, cosmetic kits and gustatory games:**
  This standard EN 71-13 is intended to reduce the risk and problems for the child's health when playing games table olfactory, cosmetics kits and games tastes taking into account the behavior of children. Hazards should be minimized during the use of said toys by providing the appropriate information that makes the game safe and controllable. Therefore, this European Standar specifies the warning phrases and instructions for use of such toys.

As a general rule, toys are designed and manufactured to specific ages of children, and their use presupposes certain aptitudes. Therefore, age requirements are provided. The requirements of this European standard do not exempt parents or guardians of the responsibility to watch the child when he or she is playing. On the contrary, the use of these sets it requires close supervision by adults.

5.1.2. UNE-EN ISO 14001:2015 Environmental management systems.

Organizations of all kinds are increasingly interested to achieve and demonstrate a strong environmental performance through the control of the impacts of its activities, products and services about the environment, in accordance with its policy and objectives environmental They do it in the context of legislation every time more demanding, the development of economic policies and other measures to promote environmental protection, and an increase of the concern expressed by the interested parties for the environmental issues, including sustainable development.

This international standard specifies the requirements for a environmental management system, designed to allow a organization develop and implement a policy and objectives that have legal requirements and other requirements that the organization subscribe, and information regarding the aspects significant environmental.

This international standard applies to any organization that want:

- Establish, implement, maintain and improve a system of environmental management.
- Ensure compliance with its environmental policy established
- Demonstrate compliance with this international standard by:
  - Carrying out a self-assessment and self-declaration.
  - The search for confirmation of such compliance by the Stakeholders in the organization, such as clients.
  - The search for confirmation of your self declaration by a part external to the organization.

- The search for certification / registration of its environmental management system by an external party to the organization.

All the requirements of this international standard have as an end its incorporation into any management system environmental. Its degree of application depends on such factors as the environmental policy of the organization, the nature of their activities, products, services, location and conditions in which it operates.

5.2. Patents

All innovation is susceptible to legal protection through an industrial property modality that guarantees its owner an exclusive right to its exploitation. Inventions are protected by patents. The basic reason for legal protection is to ensure that the innovator monetizes the investment necessary to obtain the innovation, protecting it against encroachments by third parties.

Therefore, before starting any design, it is advisable to make a search for patents in the area of the product studied, finding similar products or having things in common.

For this we have carried out an exhaustive search in several pages, which I attach later in the bibliography, about board games, with miniature pieces, dice and question cards, and these are the similar patents found:

5.2.1. Board game involving multiple variables and performance determination.

| Number	US4279422A
Inventor	Mark Shaw
Original Assignee	Mark Shaw
Priority date	1979-03-15

Abstract: A game simulates attending college. Apparatus of the game includes a game board upon which two separate paths of play are defined. One path of play is a college path which represents various academic and financial occurrences which befall the student-player. The other path defines a financial path which represents various financial occurrences which befall the player while working and not attending college. Each path is defined into intervals which designate various rewards or credits or detriments. Play begins on the financial path with the objective being to collect sufficient funds to attend college. Play continues on the college path once sufficient funds have been obtained. While playing on the college path, college credits or detriments are collected and are attributed to college classes or events attempted during each round of play on the college path. A performance determination in the form of a grade point average is derived by play on the college path. If the expenses of attending college exceed the funds collected by any player, play must be transferred back to the financial path. Play remains on the financial path until sufficient funds are collected to once again return to the college path.
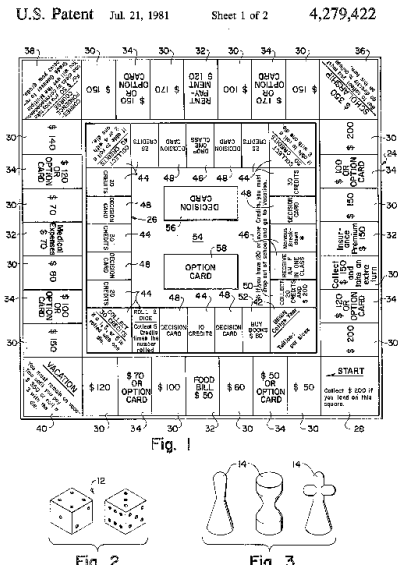
5.2.2. Cultural knowledge board game.

Number	US5257939A
Inventor	Don T. RobinsonJune Huckabee
Original Assignee	Robinson Don TJune Huckabee
Priority date	1992-10-13

Abstract: The invention provides a board game apparatus for an educational board game, with a plurality of playing cards and playing tokens.
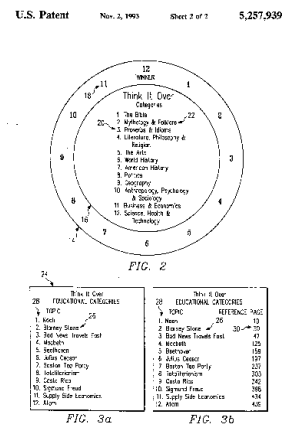
5.2.3. Educational world map game.

Number	US4052072A
Inventor	Philip E. Beal
Original Assignee	Beal Philip E
Priority date	1976-02-23

Abstract: An educational world map game adapted to be played on a pachisi-like game playing board bearing the world continental areas with countries marked off and lines of playing spaces to be traversed by playing pieces counted off in number according to the roll of dice and directed by a drawing of a card or playing piece showing the country shape in one of the continental areas. With the playing pieces being shaped as puzzle parts and each having the puzzle outline of a country, they are adapted to fit with one another and to overlie the country spaces marked off in the continental areas at the terminal ends of inwardly-extending lines of the playing spaces and these country spaces may be counted in continuation of the line space the shortest distance within the continental area to reach final country destination. The lines of spaces are arranged to provide one closed peripheral line about the board with a starting point therein and lines of playing spaces extending inwardly from the closed peripheral line at points therealong that respectively terminate in the respective continental areas. The playing piece is advanced along the lines of playing spaces and into continental areas according to the rolling of dice by the players. The game is completed with all of the countries provided for the continental areas being placed therein and the winner will be the player who has located the greater number of countries in the continental areas or scored the most points according to variations of the game.
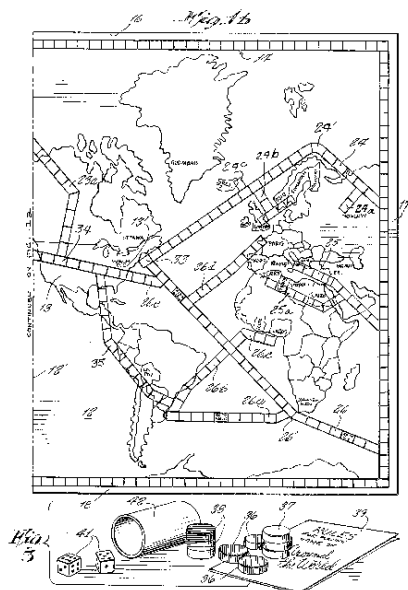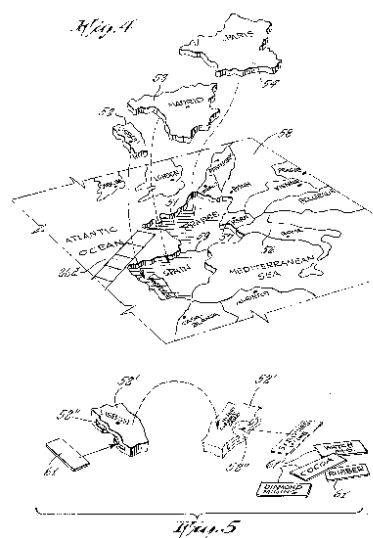
5.2.4. Battle-simulation game.

Number	US2799504A
Inventor	George J Keyko
Original Assignee	Teacher Toys Inc
Priority date	1955-01-18

Abstract: A game for simulated battle between two opposing forces, comprising: a game board having a map on one surface thereof; a plurality of spaced parallel lines extending across said map in one direction and being in tersected at right angles by a second plurality of similarly spaced parallel lines to form a pattern of squares on said map; boundary means on said map dividing said map into a non-symmetrical inner section and a non-symmetrical outer section completely surrounding the said inner section; means defining a first prisoner site in said inner section and occupying an area including a plurality of complete squares; means defining a second prisoner site in said outer section at an outer extremity of said map and occupying an area including a plurality of complete squares; means dividing said inner and outer sections into generally concentric annular zones being respectively identified as woods and open fields; two sets of game pieces, each set comprising a plurality of differently shaped pieces formed to represent military personnel and equipment and being sufficiently small in size to be accommodated within any one of said squares, whereby a plurality of said game pieces may be accommodated Within either of said sites said respective sets of game pieces having identification means thereon indicative of one of said forces, whereby a'simulated battle may be engaged in between one of said forces protecting said outer site and the other of said forces protecting said inner site by movement of said game pieces from one of said squares to another.
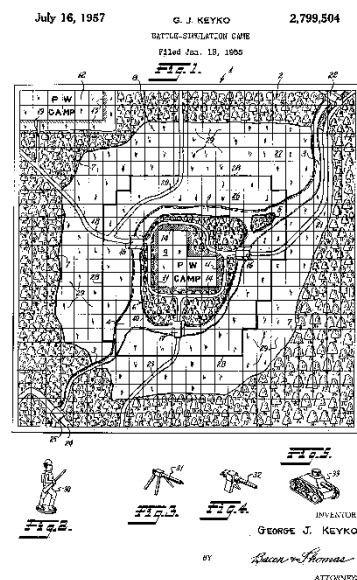
5.2.5. Set of dices for lottery.

Number	US4678190A
Inventor	Yves Dery
Original Assignee	Yves Dery
Priority date	1986-03-18

Abstrac: There disclosed a set of cubic dices to be thrown on a surface for aiding a lottery player in the selection of hopefully winning numbers. The dices are suited for a lottery of the type in which a player selects a predetermined number of integers in a given series of such integers. The numbers of dices in the set is equal to the number of integers to be selected in the specific lottery type. At least some of the six faces of each dice bears at least two distinct integers facing in opposite directions and forming two series of lottery integers. The dice integers are distributed on the various dice faces such that each integer will appear on two dices and such all the integers on any given dice will not appear on any other single dice but will be distributed among the remaining dices of the set. The dices are successively thrown and each time the player has to pick the integer facing him. After each throw, the player has a chance of picking any of the remaining non-chosen integers.
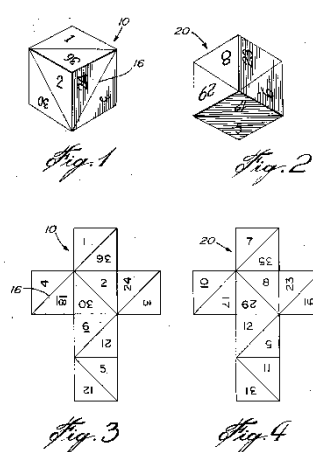
5.2.6. Game of dice for blind or persons with poor vision.

| Number	DE2907553A1
Inventor	Hans Heitmann
Original Assignee	Hans Heitmann
Priority date	1979-02-26

Abstract: Dice system used for blind persons or people with limited vision, consisting of a dice throwing beaker which can be covered and at least one die having one symbol on each of its surfaces. Each surface of the dice has a recess with side surfaces falling at an incline and a level base surface positioned parallel to the edges of the die. On the base surface there is a nap or protrusion which can be felt, and which represents the symbol. The throwing beaker has a catching device with a window accessible from outside which is size corresponds to at least one die surface and which holds at least one die after ending the throwing operation in such a way that at least one nap of the dice surface facing the window of the catching device can be touched by the player's finger from outside.

5.2.7. Logic puzzle for use by blind person.

Number	FR2507490
Inventor	FOURNET DIDIER
Original Assignee	FOURNET DIDIER
Priority date	10.06.1981

Abstract: The game is a cube made from small cubes that can be rotated round three axes to change the faces. Each face of the small cubes is marked with patterns that can be recognised by touch. The marks can be raised or hollowed out and they can be Braille characters. Groups of nine faces from each face of the large cube and there are six groups of faces each with a distinctive mark. The faces can have distinctive colours, corresponding to the marks, so that it can be used by a sighted person.
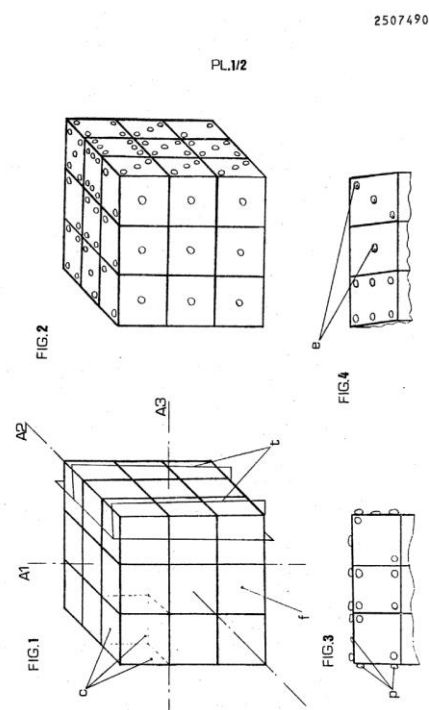
### 5.2.8. A game for blind and partially sighted people.

Number	GB2387553
Inventor	BEAUMONT THOMAS HOBDEN
Original Assignee	BEAUMONT THOMAS HOBDEN
Priority date	07.03.2002

Abstract: An apparatus to enable a visually impaired person to play a game such a bingo comprises a base 1, end caps 2, and a spindle 3. Preferably elements 4 such as braille dominoes are attached to the spindle so that a number called may be identified and flipped over by the player. The end caps may be removed to change the elements as required.

5.2.9. Sudoku game playing device for blind person.

Number	FR2922462
Inventor	GRIMAULT PIERRE
Original Assignee	GRIMAULT PIERRE
Priority date	17.10.2007

Abstract: The device has a support plate representing a sudoku grid with 9 regions. Each region has 9 cells to receive stable and movable pieces numbered from 1 to 9. The pieces have upper surfaces comprising figures embossed with Braille alphabet and Arabic figures. Base of the stable pieces is straight so that the stable pieces are not tilted during handling. A light raised mark is provided at the base. The movable pieces have a color different from that of the stable pieces. Base of the mobile pieces is relieved so that the mobile pieces are tilted by slightly supporting on ends of the mobile pieces.
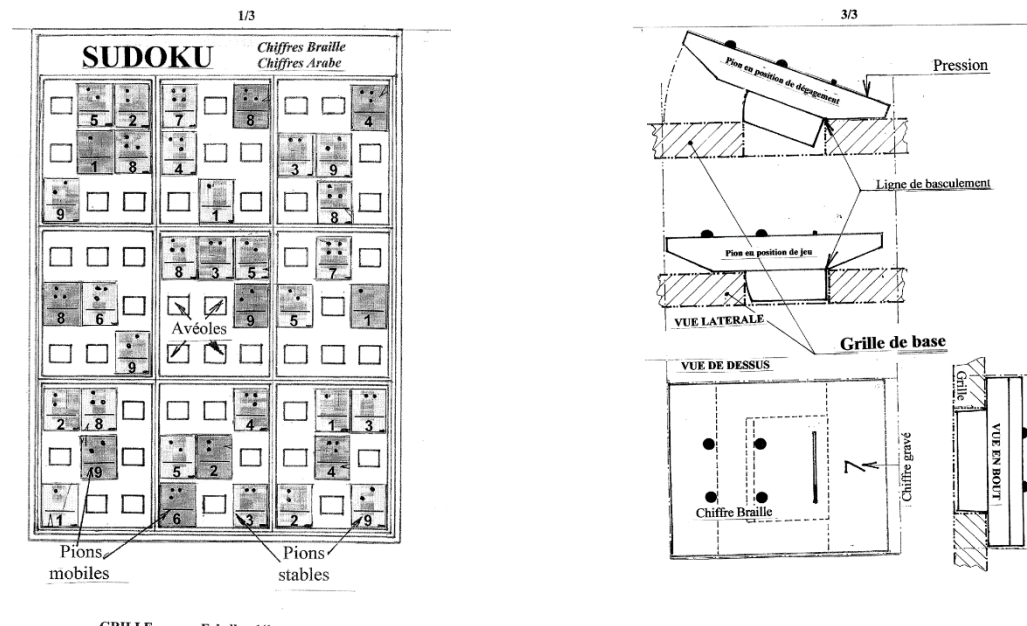
6. Methodology used

6.1. Summary

In this project we will carry out the development of the design of a board game adapted for children with visual disabilities.

In the next section I describe the entire process, from how the initial idea was born, to the creation of said game, showing both the reasons that have led me to the choice of the product and the objectives that I have marked with its development.

I will also break down all those methods that have used me made possible the obtaining of the optimal results of the conceptual design and the conclusions.

6.2. Aim

At the beginning of this project what motivated me to choose this idea was the fact of being able to mix engineering with children, since they are two things that I like and enjoy with them.

Therefore, as a mechanical engineer specialized in design, I thought it would be a good idea to use CAD knowledge and then 3D printing processes to design a product capable of facilitating learning, developing physical, mental and emotional capabilities,

being an integrating tool, of improvement of the social relationship, and that at the same time could provide entertainment and finally, happiness.

And to make the idea more original, and with the aim of making it even better for society, I added the fact that it is an educational game aimed at children with visual disabilities.

6.3. Methodology

With the aim and the user already defined, the next step was the decision of the type of product/service to be developed.

The first step was therefore to obtain ideas, for this I have used the **Brainstorming** technique in the specific area.

With this I got a first list of possibilities: Braille book, card game in braille, game with sounds to sharpen the sense of hearing, etc.

The next step involved a broad search on the Internet: **GoogleStorming** and **GoogleTrends**, with the application of this method could:

- Narrow down much more the type of product that finally would develop, discarding products that already existed in the market.
- Conduct a study of possible competition.
- Find similar products, adaptable to the idea.
- Look for technical solutions, which, although, were used in products that had nothing to do with their own, could use.
- Collect information on materials and manufacturing processes.

At this point in the process, with the information obtained, I had quite clear already, the type of product I wanted to develop, the decision was to focus on getting a board game for people with visual disabilities, now I had to use tools that would help me to further develop the product.

7. Adopted solution

7.1. Europe map

Carrying out the market study we found a very interesting project of a map of Europe, made in Spain, carried out in the way that we would raise it, and that we will

explain next. Therefore, instead of manufacturing it, we decided to buy it, since we saved time and, as we will see later, in the budget section, money.

The authors present the project launched by the Relief Materials Working Group, of the Spanish Braille Commission (CBE) in 2005, consisting of the elaboration of a series of continental maps, and the autonomic one of Spain, in which they harmonize Braille lettering, embossed highlights, color and large characters. We have found several articles that describe the development of the experience, based on aspects such as the formation of an interdisciplinary working group, the establishment of basic technical criteria, the use of the technological infrastructure of the ONCE Bibliographic Service, the choice of materials with the most suitable characteristics, as well as the source maps and the areas to be represented, the projection and the scale. Braille signage was done with the parameters approved by the CBE, and the representation of the relief, the use of color and macrocharacters were normalized. The maps are accompanied by a key guide.

To carry out the evaluation of the first prototype of a political map of Europe accessible to people with visual impairment, two copies of different sizes were prepared: 29.7x42 cm (map A) and 45x60 cm (map B) respectively, which were presented to 139 users by evaluators (teachers of the Educational Resource Centers and technicians of the Relief Materials Group). Of these users, 81 were high school students, belonging to the CRE of Madrid, Barcelona and Pontevedra, and 58 were adults, from Madrid, Tarragona and Pontevedra.

The valuation questionnaire consisted of four parts:

a) Questions to determine the user profile (age, studies, profession, degree of vision, etc.)

b) Practical tests of location of elements in the map, in which the time it took to perform them was timed.

c) Users' assessment of the representation of elements on the map: borders, seas and oceans, islands, capitals, etc.

d) Questions for the user to define their preferences regarding both accessibility and the format of the maps to be evaluated.

In addition to a section of observations.

Results according to preferences:

	Map A	Map B	No preference
Accessibility to the elements	10,3%	82,7%	7%
Handling of maps	19,7%	58,8%	21,5%

The results obtained in the questionnaires, together with their observations and those of the evaluators, were used for the definitive production of the political map of Europe.

The pilot project of political map of Europe was presented at the "International Conference of Cartography: cartographic initiatives for a world in transformation", which, under the organization of ICA (International Cartographic Association) took place in La Coruña between 9 and 16 July 2005.

http://cidat.once.es/home.cfm?excepcion=52&idproducto=502&idseccion=02

7.1.1. Map relief design.

Relief	Represented element
Texture of horizontal lines	Seas, oceans and lakes
Smooth extensions	Represented countries (continental or island)
Dotted lines	Borders
Granulated texture	Neighboring continents

Semi-spherical points	State capitals
Square dots	Cities with more than one million inhabitants
Continuous lines	Large rivers and tributaries
Increasing relief mass	Mountain

7.1.2. Macrocharacters: font size used in maps.

Font size	Represented element
24 points	Abbreviations of names of countries, bays, capes
30 points	Seas and oceans
36 points	Name of the map

7.1.3. List of colors for continental political maps.

| Colours	Represented element
Light Blue	Seas, oceans and lakes
Light Grey	Continents bordering the represented that are not mapped
Yellow	Countries
Red	Countries
Blue	Countries
Green	Countries
White	Countries and ice shelves of the Antarctic continent
Black	Countries

Each map comes with an attached guide in which the abbreviations and the color of the countries represented on the map are presented in alphabetical order, then its capital, the bordering countries and finally, the seas and oceans.

## 7.2. Design and choice of monuments and pieces.

The first step will be to choose some designated monuments of each country that we want to introduce in the game, to later design them in CAD, with the Solidwork program and then print them with a 3D printer. We will also design players and dice in the same way. For the size of all these pieces to scale, the size of the map has been considered, so that they are consistent, and the specifications indicated by the UNE-EN 71 standards regarding toys. We have also made players with different ways to stimulate recognition by the touch of blind users, and also different and striking colors for those users who have a minimum percentage of vision to stimulate the sense of sight. The design of the dice is based on the ergonomics of the user's hand and the raised points for the reading of the points.

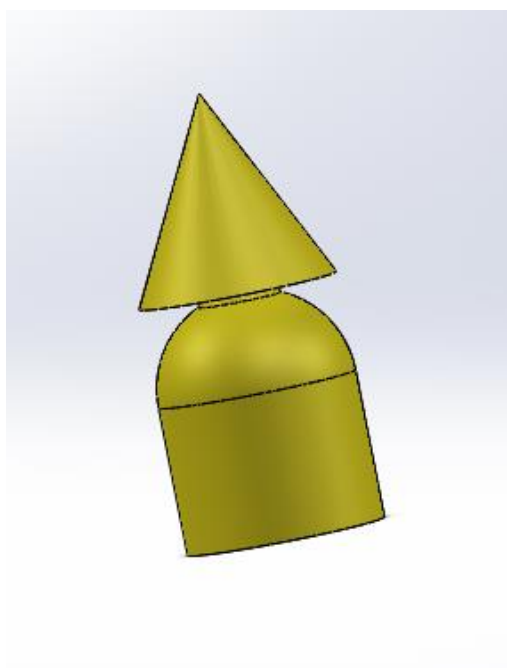All the drawings of the figures are attached at the end, in the annex.

7.2.1. Players.
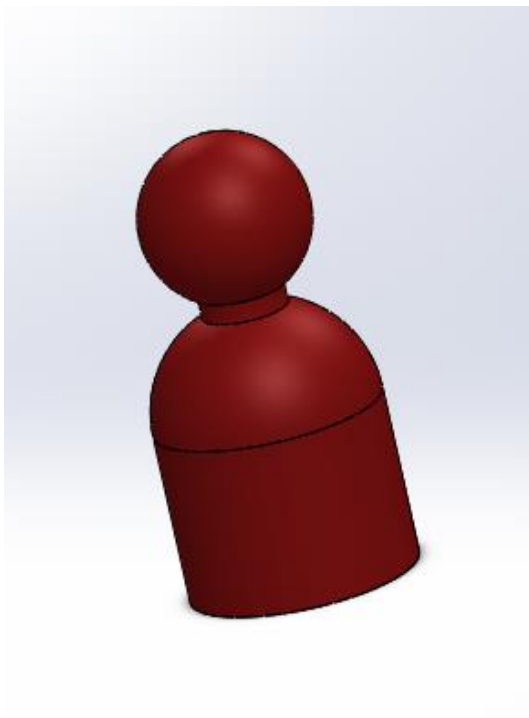
Player 1
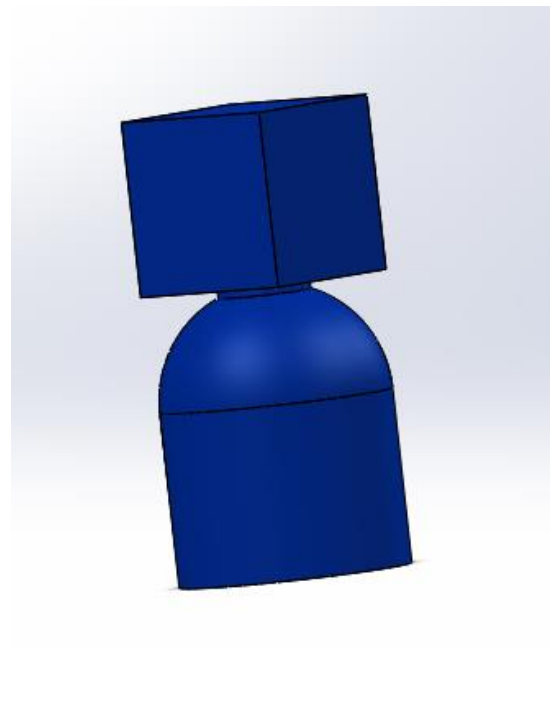
Player 2

Player 3


Player 4

7.2.2. Dices.

7.2.3. Monuments.

For the monuments the same procedure is used as for the pieces and dice. But to make the monuments in detail we need a lot of level and dedicate a lot of time, therefore, we have looked in a CAD library, whose link attached in the bibliography, the monuments that we wanted and we saved to design them.
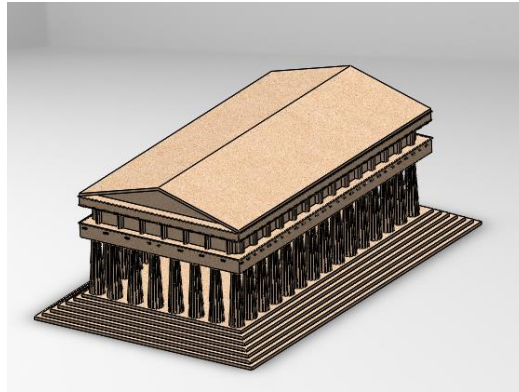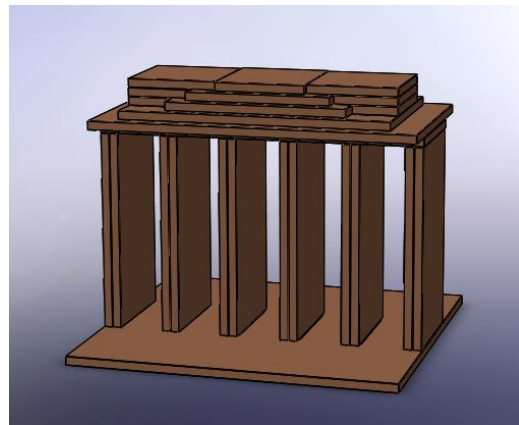
The chosen monuments have been:

- Atomium (Belgium)
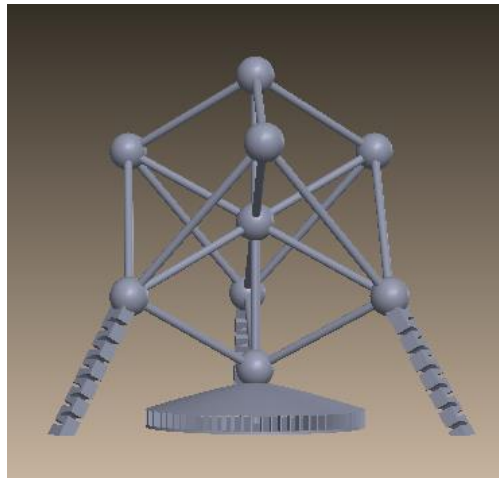
- Big Ben (UK)

- Partenon (Greece)

- Brandenburg Gate (Germany)

- Tower of Pisa (Italy)

- Eiffel tower (France)

7.2.4. 3D printing.

To make the prototypes we used the 3D printer. We thought it was a good method because it speeds up the production and sale time, which will allow you to obtain the product you want in less time and with the highest possible quality. It is also a very economical method that allows us to save money, and therefore more profit. Not to mention that it is the best method of innovation.

For 3D printing we can use a variety of materials, such as Nylon, PC, PVA, POM, PETG, HIPS, electroconductive ABS, etc.

Those closest to our needs, besides being the most used in the market are PLA and ABS:

	Melting temperature	Work temperature	Large piece	Post process	Contraction of the piece	Reusable
ABS	240	150	Yes	Easy	Higher	Yes
PLA	200	70	No	Medium	Less	No

But the latest innovation is a 3D printer that works with PVC filaments (3DVinyl).

PVC is a plastic like PLA and ABS, but also has better mechanical properties. It has strength, flexibility, is pleasant to the touch, and also has lower temperatures of fusion and work. Therefore it will be the material that we use to manufacture our pieces.

Our company has this innovative 3D printer (888), which in addition to working with rigid PVC, can also work with any other material.
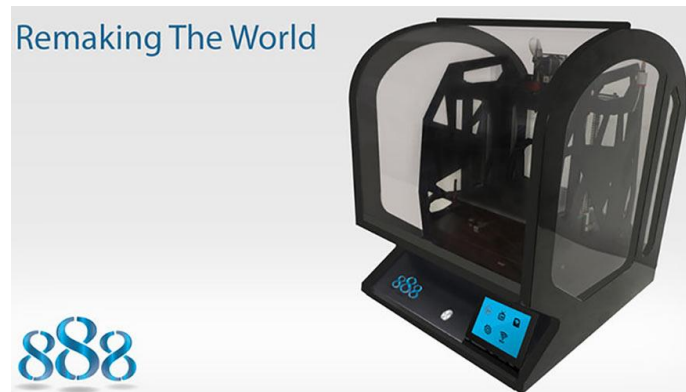
7.2.5. Choice of suction cups.

The purpose of the suction cups is to attach the maps to the table, in this way we ensure that when users feel the relief of the map does not move and the reading of Braille is more comfortable. With a pressure of 2 kg per suction cup is more than enough.

7.2.6. Choice of the magnets.

The magnets are incorporated in the monuments and have mission to locate the pieces in the correct area of the political map, the neodymium magnets are suitable for this purpose.

7.2.7. Design of question cards.

The question cards have been designed based on the technical specifications grammage, textures, color coding, braille system. As for the questions, they are based on the knowledge acquired by users in the age range.

8. Game documentation

8.1. Card questions

In the game there are four types of cards with questions, of four different colors, representing the different topics that exist. Within each question we have 4 options, to make it easier, and on the back of each card the correct answer.

The questions are written in English and in Braille so that they can be interpreted by blind children as well as children without any type of disability.

The topics are: **Culture, Gastronomy, Geography and Sport**

Board game for children with visual disabilities.

Who discovered America in 1492?

A	Colón	
B	Napoleón	
C	Platón	
D	Einstein	

Correct answer: **Colon**

It has eggs and potatoes. It is typical of Spain

A	Pizza	
B	Omelette	
C	Sausages	
D	Pierogis	

Correct answer: **Omelette**

What is the capital of Poland?

A	Warsaw	
B	Wroclaw	
C	Gdansk	
D	Krakow	

Correct answer: **Warsaw**

Who was the winner of the last Rolad Garros?

A	Novak Djokovic	
B	Roger Federer	
C	Andy Murray	
D	Rafael Nadal	

Correct answer: **Rafael Nadal**

8.2. Game rules

Geotactile Europe is aimed at children with and without visual impairment, the game aims: on the part of children:

- Recognition of the geographical situation of countries.
- Learning your capital.
- Recognition of the adjoining geography (countries, seas, oceans, mountains, peaks, mountain ranges).
- Learning, association and formal recognition of the most significant monuments of each country.
- To familiarize the child with the different European cultures, its gastronomy, music, writers, language, characters, history, traditional dress, anecdotes, art and curiosities.

- **Nº of players**: from 2 to 4 players.

- **Material:** Two maps in relief one physical and one political. Two guides one for each map. Cards of questions distinguished by 4 subjects. Two dice with raised points (tactile). 35 monuments, representative of the countries of Europe.

- **Object of the game**: Achieve the maximum possible points, answering the different questions / tests formulated in the cards. The player would add points according to the successes achieved, to get X points will win the game. (The number of points can be chosen by the players themselves, depending on whether they want to play longer or shorter games.)

- **Way of play**: By order of position the player throws the dice, the one that obtains the highest score begins. There is a different piece for each player, these pieces will be moved in an orderly manner by the map, following the line that marks that order, the number that the dice mark will be the number of countries that you must advance. Once you are placed in the country that touches you, you can choose question or map. If you choose a map, you can hit it by recognizing the monument and the reliefs, the capital, the surrounding countries, the seas, etc. The more things you get, the more points. But if you fail, you lose your turn. If instead, you choose card you can only answer one, and the success will only be worth 2 points.

(The game contains the same rules and way of playing in Braille.)

9. Product specification

9.1. Object and scope of product specification

The game is made up of two maps with suction cups to fix, some pieces and their respective magnets, two dices, some question cards and a manual of instructions for use and two guides for the maps. We will not manufacture the following items:

- The paperboard.
- The cardboard
- Plastics.
- Magnets.
- Suction cups.
- Maps and guides.

All this will be supplied to us and we will manipulate it following the technical specifications (dimensions, finishes, materials ...) to obtain the expected result.

In the case of inconsistencies in any of the documents, the information must be contrasted according to the following hierarchy between the parties of the project:

- For the dimensions and geometric characteristics of the described products, the plans on the memory or the sheet will be valid.
- Regarding the characteristics of the materials and the description of the manufacturing and assembly process, what is stated in the specifications will prevail over what is written in the other documents.
- For the description of the design process and decision making on the form and characteristics of the products developed, the document to be consulted will be the report.

9.2. Conditions of supply, characteristics of materials and technical specifications of manufacture.

9.2.1. Cardboard.

In the Project there are several elements made with cardboard, such as the question cards and the user manual. Setting the color code for each theme.

The type of card we have chosen is: **WLC (White lined chipboard)**. This cardboard consists of cellulose on the sides, paper in the middle and cellulose or recycled paper on the back. The cardboard distribution company must meet the quality standards that we require, and these will be already cut according to the measurements of the plans we will send them, anyway, the necessary sizes will be A-4.

Virgin fibers will be used, so that they can be in direct contact with food, having the HACCP certificate, which implies an improvement in the handling of internal processes, to guarantee the safety of the cardboard. Essential requirement of the supplier is to have the **ISO 9001: 2015 and ISO 14001: 2015** certifications, which must reflect a concern for the quality of their products and the continuous improvement thereof and the balance of the environment.

The supplier company oversees the manufacturing process of the cardstock. We, once these arrive, we print them, cut them to the exact size we need and then proceed to the punching to make the braille.

9.2.2. Rigid PVC

As a general criterion, the material that should be used to produce the dies must be sufficiently rigid and stable to withstand abrupt changes in temperature without breaking or splintering, and so that it can be subjected to manipulation and machining processes (milling and heating processes). multitermoconformado).These materials include, among others, resins, rigid PVC, metal and methacrylate.

As for the characteristics that the most suitable material for the preparation of the copies of each map must meet, we can list the following:

- Resistance
- Flexibility.
- Durability.
- Be pleasant to the touch.
- Accept silkscreen well.
- Be permeable to thermoforming.

PVC - vinyl polychloride - is a fire retardant, resistant to UV rays, weathering and chemical agents, has a great thermal stability, and has good mechanical properties, rigid and resistant.

But the 3DVinyl, PVC filament for 3D printer, has more properties and is that it adheres well to the printing bed, and does not suffer from warping.

Our company has an 888, an FDM machine that specializes in this material, but can also print with the rest of the market materials. Therefore, we only have to buy the material, enter the plans in the machine, both our own designs, for the dice and players, as well as those downloaded from the CAD library for the monuments, and we will have all our pieces.

9.2.3. Characteristics of magnets.

- MAGNET(8x3mm) 10 Units.
  - Barrel shaped.
  - Nickel-plated for maximum durability.
  - Very powerful magnets.
  - Permanent magnetic excitation.
- Specifications:
  - Neodymium material
  - Values N35-N45.
  - Dimensions Ø8 x 3mm.

We will also buy these magnets from another company.

9.2.4. Characteristics of suction cups.

- Brand: N/A
- Model: 10050134M
- Quantity: 2 pieces per pack.
- Colour: Transparent
- Material: Flexible PVC
- Specification: Suitable for kitchen, bathroom wall tile, glass and other somooth surfaces
- Other features:
  - Bearing: 400g-600g
  - Package content: 2 x hooks
  - Dimensions: 4,4cm x 4,1cm x 1,5cm

And as the magnet, we buy these suction cups from another company.

9.2.5. Characteristics of maps

- Material: PVC sheet (colored screenprinting)
- Weight: 300 microns
- Dimension: 620 x 470 mm
- Braille system: point 0,5mm
- 8 geographical identification colours.

In our case, we bought the map from the CBE, which manufactured it using numerical control and screen printing machines. But, in addition, in our company, we will add by means of milling, a line with relief that marks the order that the players must follow through the countries.

Along with the maps, their corresponding guides are attached.

10.   Budget

- Rigid PVC

Object	Quantity of material	Costo of material Raw material 4€/kg
Players (x4)	0,54x4 = 2,16kg	8,64
Monuments (x35)	0,055x35 = 1,925kg	7,7
Dices (x2)	0,06x2 = 0,12kg	0,48
TOTAL	**4,097 kg**	**16,82 €**

PVC in 3D printers is a very innovative concept, but for that reason it is not yet perfected, and therefore we can not exactly calculate the costs and benefits, we can only approximate it. Therefore, it could be that when studying other options with other materials such as ABS or PLA, it would be cheaper.

- Print

Object	Raw material	Direct labour costs
Instruction manual	0,50€	2€
Card question (x200)	2,50€	10€
TOTAL	**3€**	**12€**

- Subcontracted product

Object	Company	Costs
Politic map (x1)	ONCE	2€
Fisic map (x1)	ONCE	1,50€
Guide map (x2)	ONCE	1,75€
Suction cup (x8)	Aliexpress	0,644€
Magnets (x35)	Aliexpress	2,62€
TOTAL		**8,514€**

- Total budget

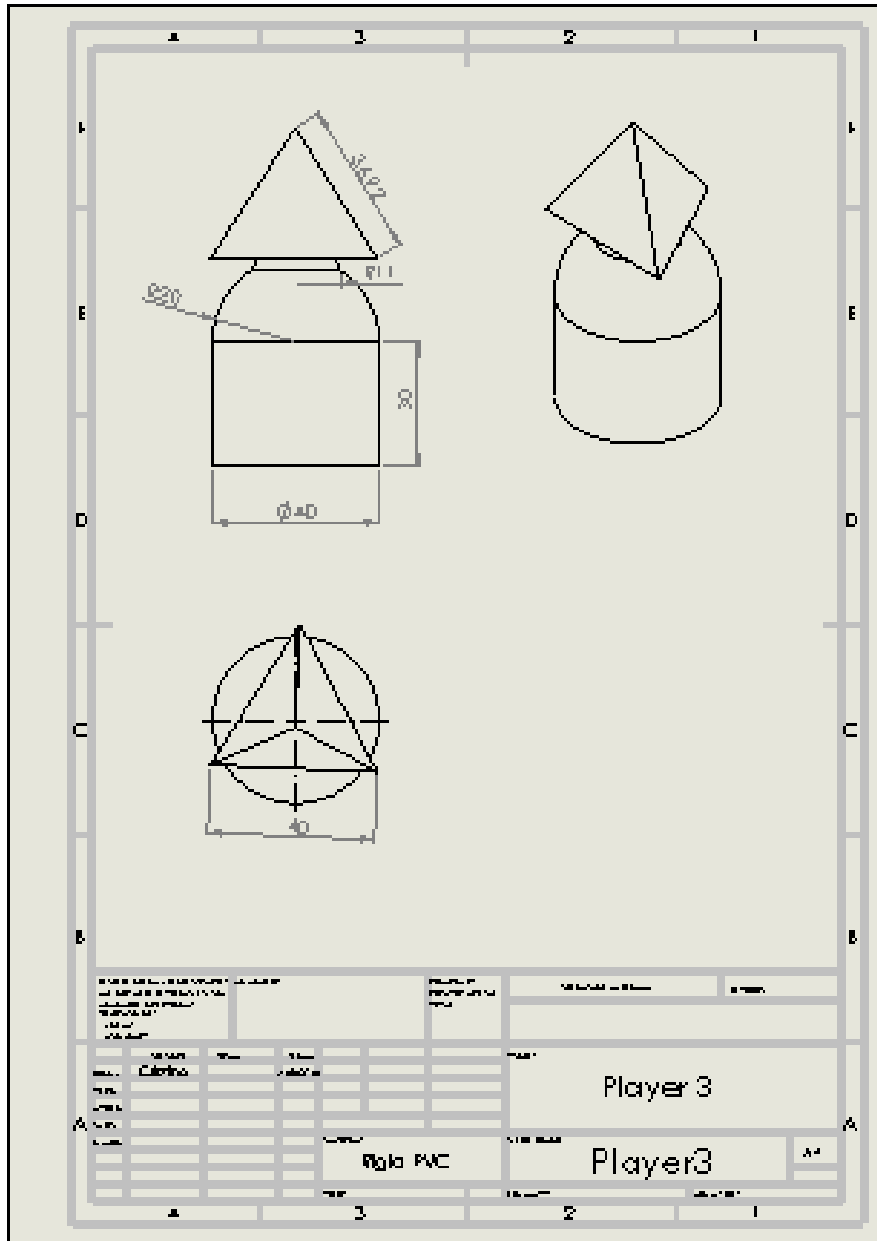| Product and operations	Cost
Rigid PVC	16,82€
Print	12€
Subcontrated product	8,514€
TOTAL	**37,334€**

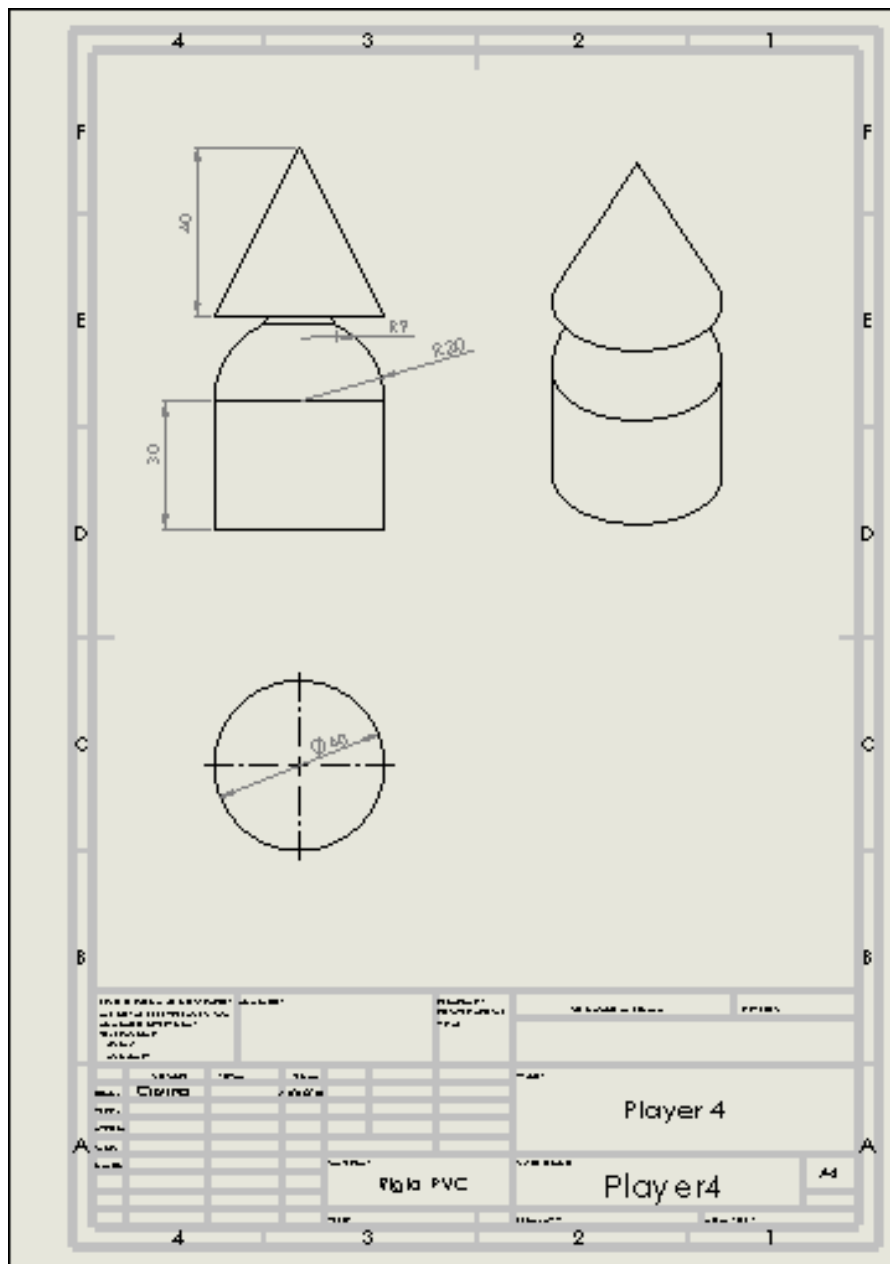# 11. Annex

11.1. Drawings
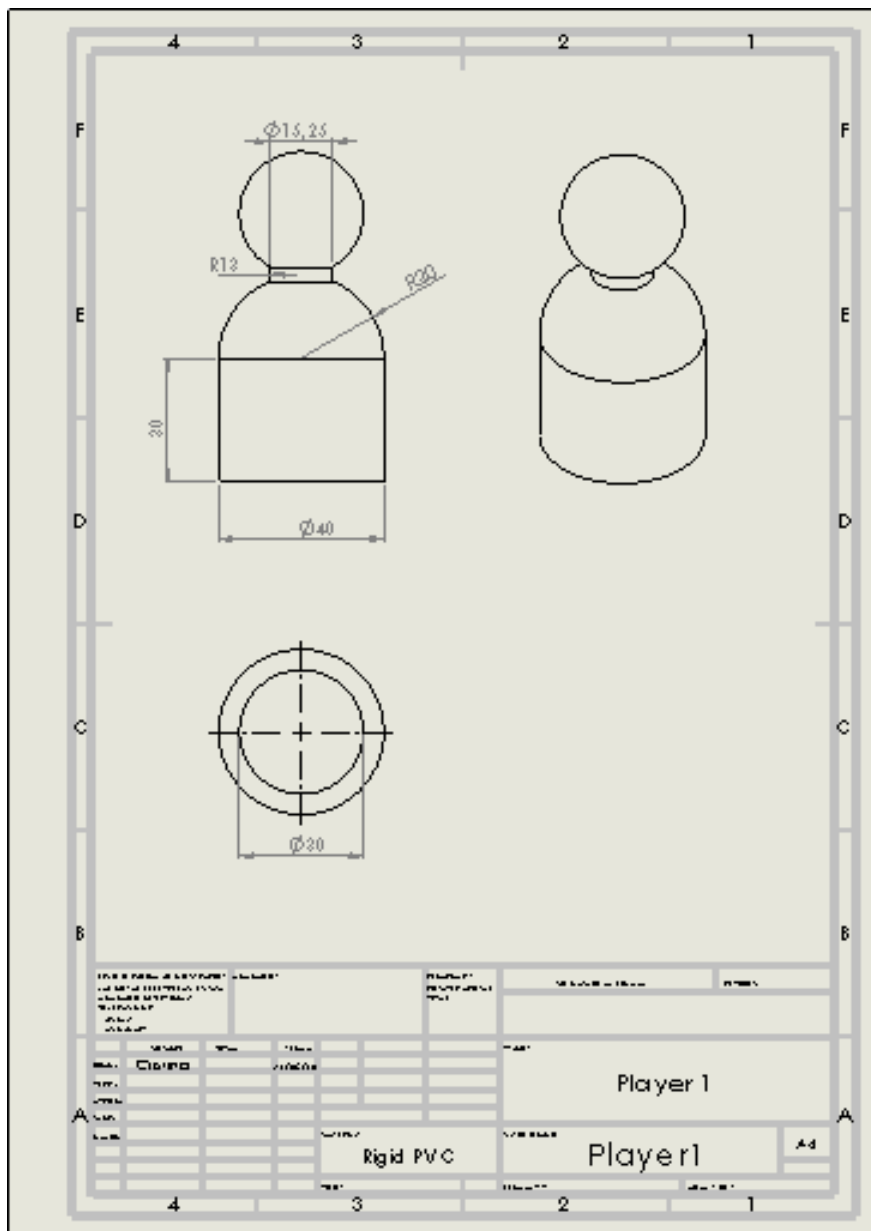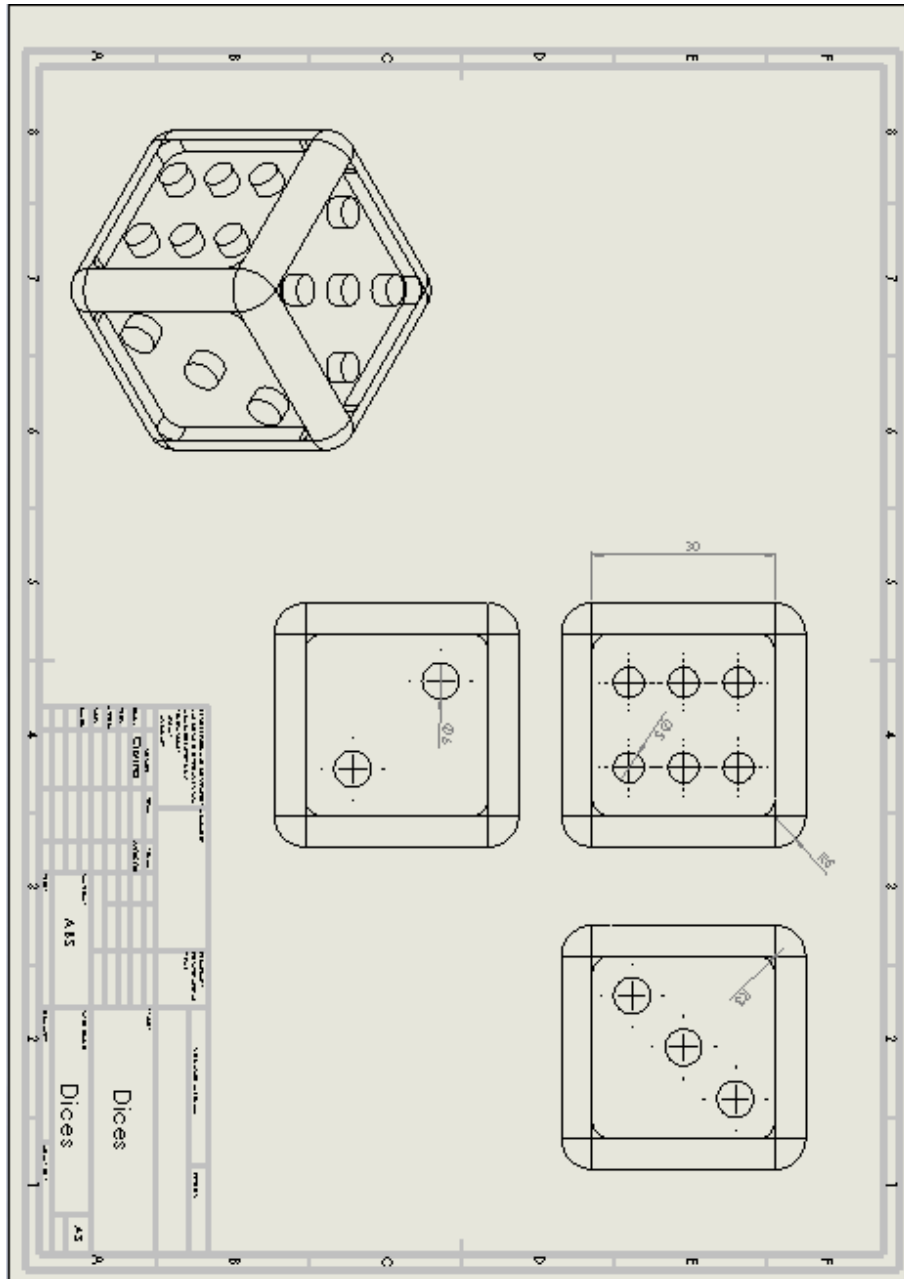

Player 1
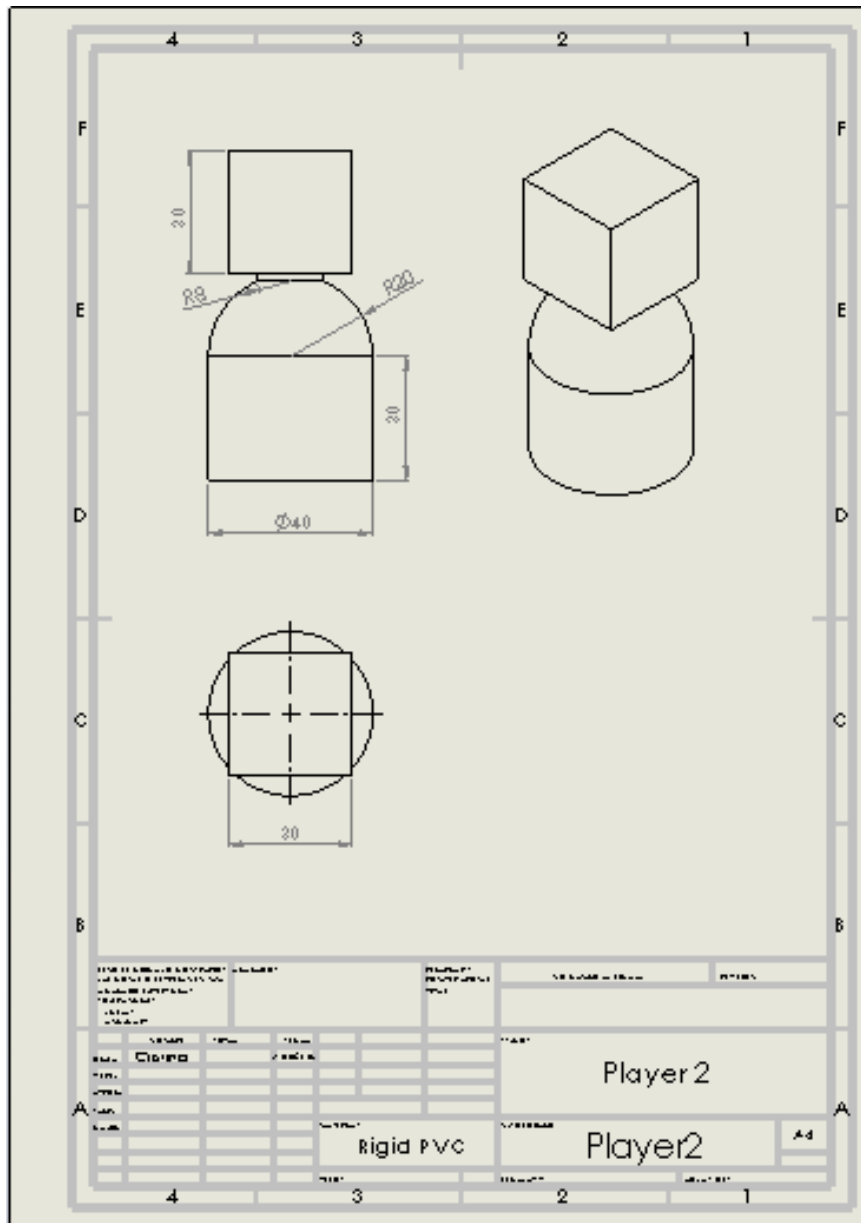
Player 2

Player 3

Player 4

Dices

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