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The Portable Virtual Content through Relative to Backpack Tracked Augmented Reality Headset.

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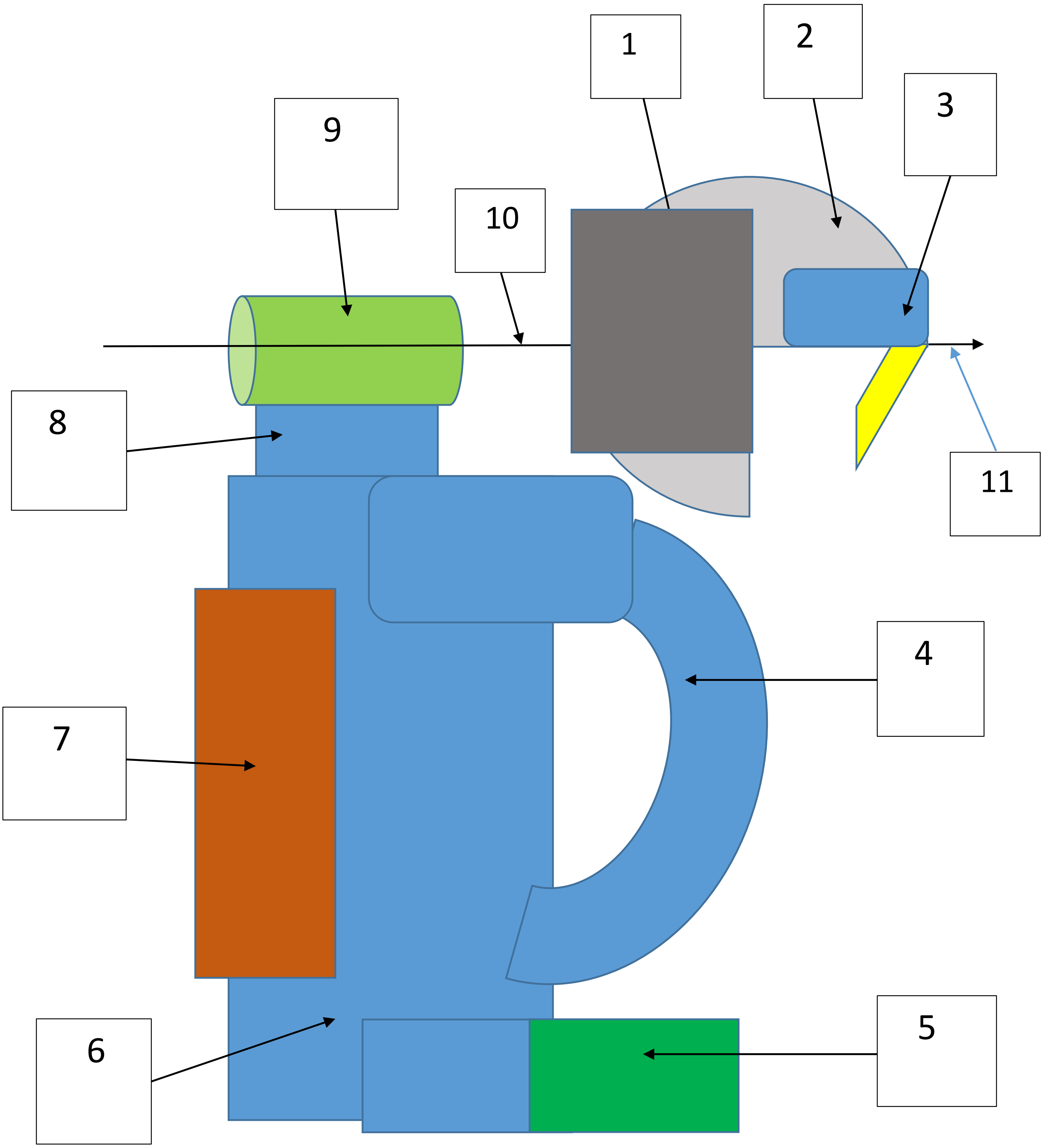
ABSTRACT

This paper describes a method to enable a portable virtual content experience. The system utilized in this method contains a backpack mounted tracking camera, a backpack mounted mobile computer and an augmented realty headset fitted to a helmet. Prior to the virtual experience the user of this system wears the backpack and the helmet. Once this procedure is completed, the user can start to experience the virtual experience. The backpack mounted camera tracks the movements of the user wearing helmet in space. Thereby this camera will track the orientation of the augmented reality headset relative to the backpack. The backpack mounted mobile computer, through the camera recorded footages generates the corresponding virtual imagery of the virtual vision the user would see through the augmented reality headset as he or she orients the headset. This tracking relative to the backpack will enable the user to experience the virtual content surrounding his or her field of view when both the user is stationary and when on the move. Thereby making the virtual content portable.

THE DIAGRAMS

The diagrams of the components of the system and the space surrounding the user are given below.

- The side diagram of the entire system.



The components of the entire system (side view)

Component one: the surface with markers.

Component two: the helmet.

Component three: the augmented reality headset.

Component four: the shoulder straps.

Component five: the waist straps.

Component six: the backpack.

Component seven: the mobile computer.

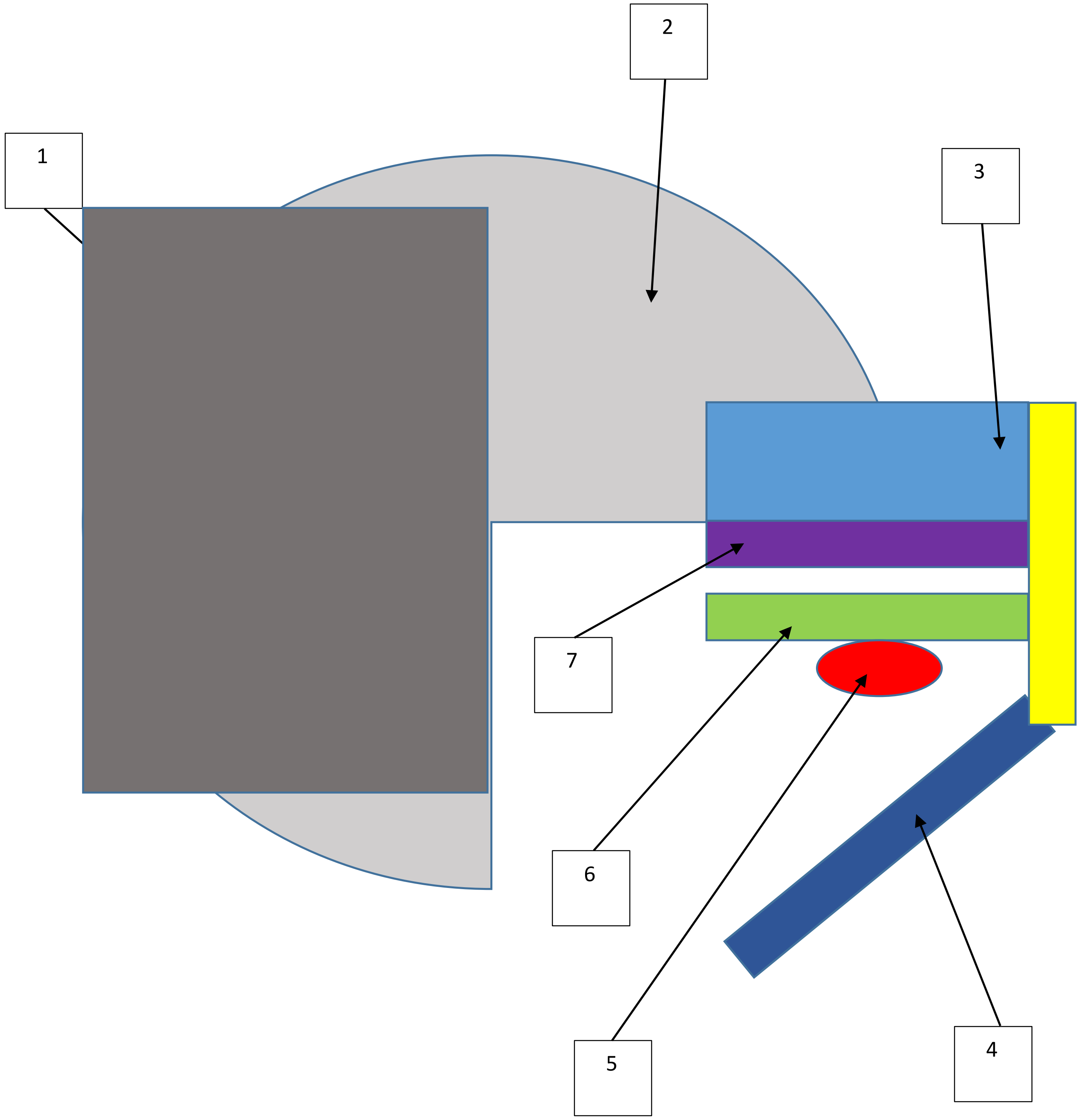
Component eight: the structure to mount the tracking camera.

Component nine: the tracking camera.

Component ten: the line going through the optical axis of the tracking camera lens.

Component eleven: the line going through the center of the helmet.

- Side diagram of the helmet with the augmented reality headset fixed to the helmet.



Components of the helmet with the augmented reality headset part. (Side view)

Component one: the right side surface with markers.

Component two: the helmet.

Component three: the structure of the augmented reality headset to which the components are fixed.

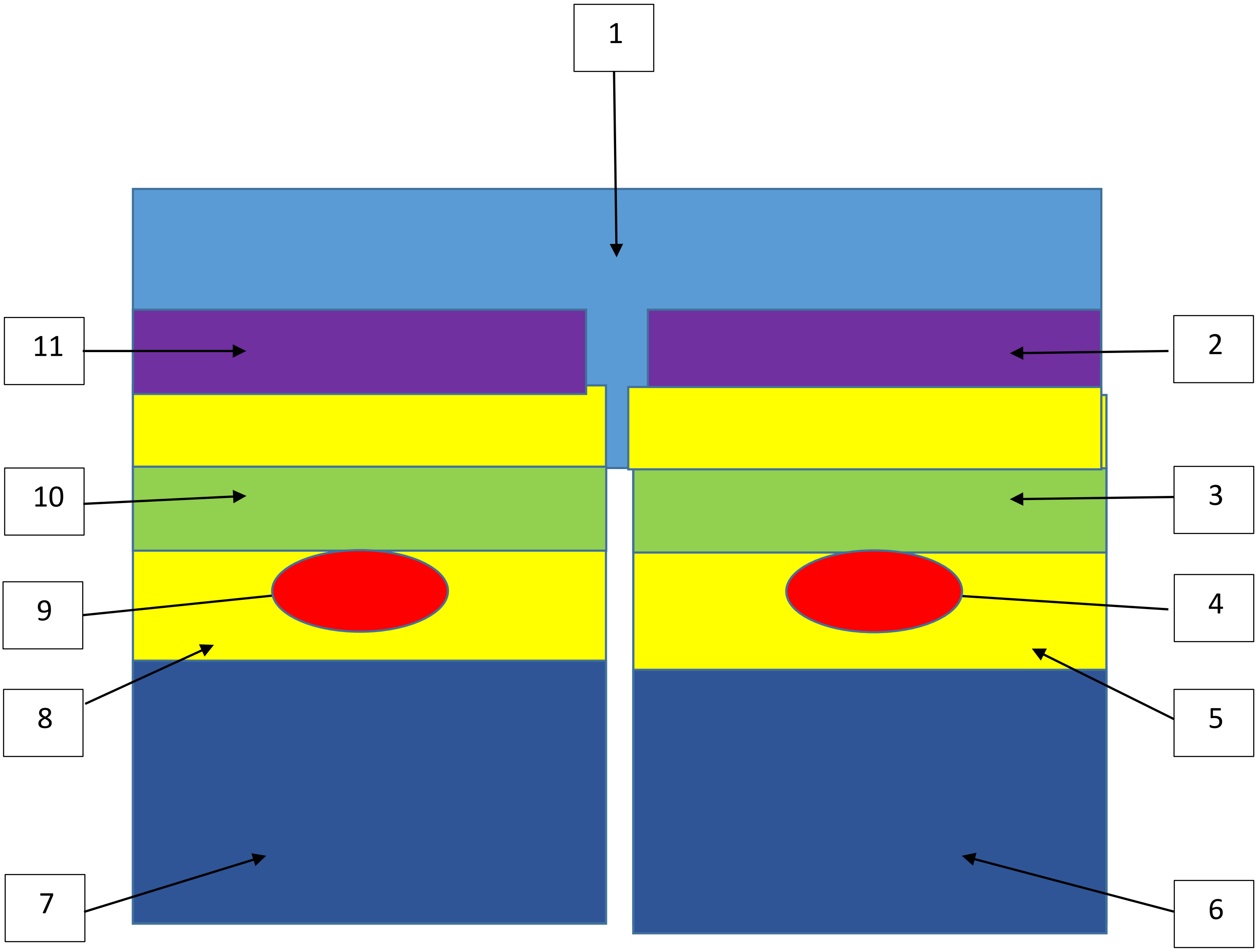
Component four: the dual beam splitters.

Component five: the dual overhead focusing convex lens.

Component six: the dual overhead transparent material plates.

Component seven: the dual overhead displays.

- The front diagram of the augmented reality headset.



Components of the front diagram of the augmented reality headset.

Component one: the structure of the augmented reality headset to which the components are fixed.

Component two: the left overhead display.

Component three: the left overhead transparent material plate.

Component four: the left overhead focusing convex lens.

Component five: the left structural part to which the left beam splitter is fixed.

Component six: the left beam splitter.

Component seven: the right beam splitter.

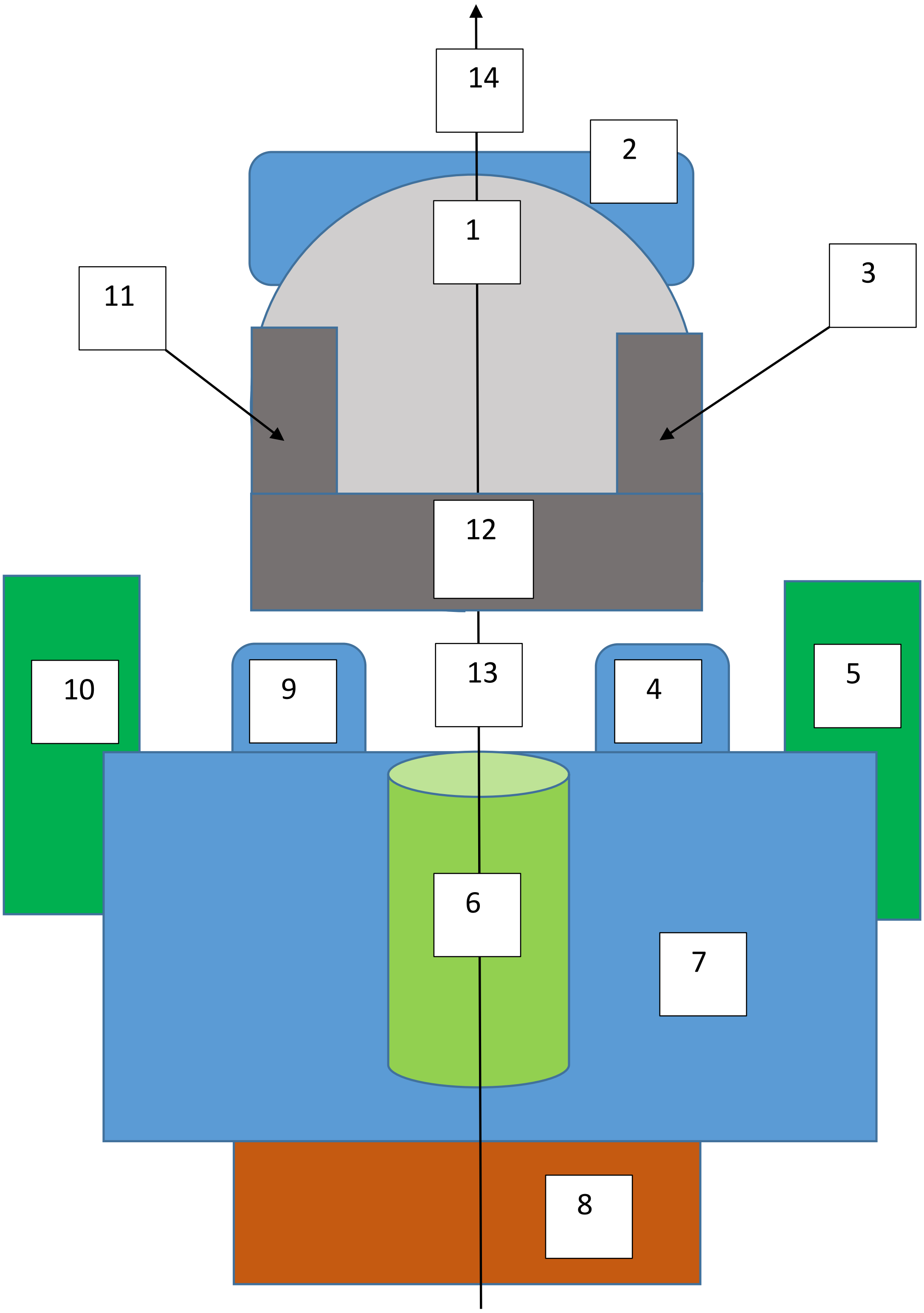
Component eight: the right structural part to which the right beam splitter is fixed.

Component nine: the right overhead focusing convex lens.

Component ten: the right overhead transparent material plate.

Component eleven: the right overhead display.

- The top diagram of the entire system.



The components of the entire system (top view)

Component one: the helmet.

Component two: the augmented reality headset.

Component three: the right side surface with markers.

Component four: the right shoulder strap.

Component five: the right waist strap.

Component six: the tracking camera.

Component seven: the backpack.

Component eight: the mobile computer.

Component nine: the left shoulder strap.

Component ten: the left waist strap.

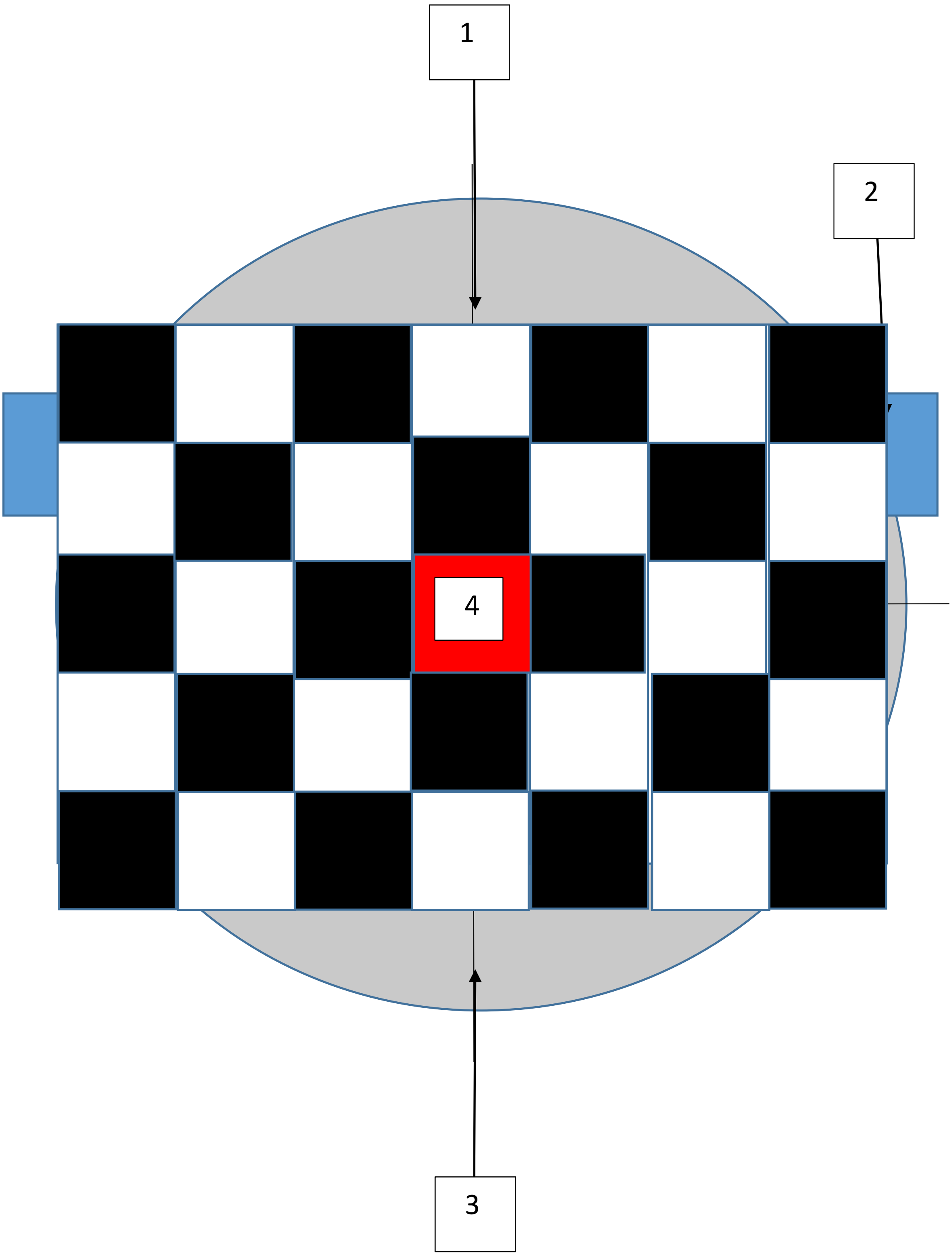
Component eleven: the left side surface with markers.

Component twelve: the rear side surface with markers.

Component thirteen: the line going through the optical axis of the tracking camera lens.

Component fourteen: the line going through the center axis of the helmet.

- The rear diagram of the helmet.



The components of the rear diagram of the helmet.

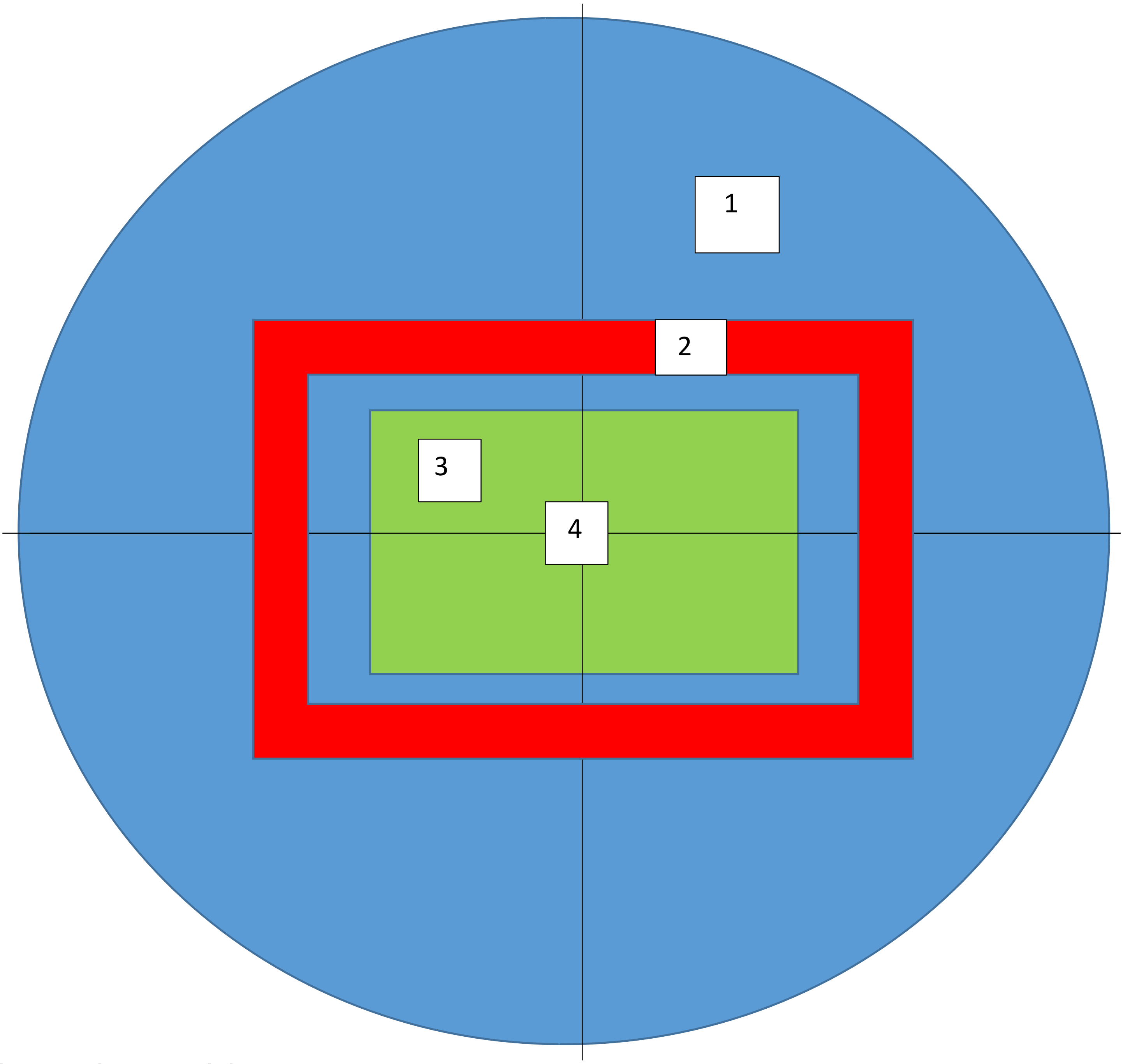
Component one: the helmet.

Component two: the augmented reality headset.

Component three: the rear side surface with markers.

Component four: the center of the rear surface with markers.

- The surrounding space.



The components of the surrounding space.

Component one: the blue colored space represents the space surrounding the user where the virtual content are augmented into.

Component two: the red colored rectangular boarder region represents the binocular overlap region equivalent of the field of view of the average human that will be positioned directly in front of the optical axis of the tracking camera.

Component three: the light green colored rectangular region represents the unobstructed view of the real world that will be positioned directly in front of the optical axis of the tracking camera.

Component four: the center of the unobstructed view of the real world rectangular region.

<u>All the components of the entire system that will provide the portable virtual content experience.</u>

- The components of the helmet and the augmented reality headset.

Component one: the helmet.

This is the helmet to which the augmented reality headset and the three surfaces with markers are fixed. The following components are fixed to this helmet directly or indirectly-utilizing other structures. Components (two,three,four,five,six,seven,eight,nine,ten,eleven,twelve,thirteen). The user of this system puts on the helmet prior to experiencing the portable virtual content experience.

Component two: the structure of the augmented reality headset to which the components are fixed.

This structural part is fixed to the helmet. All the other parts consisting of the augmented reality helmet are fixed to this part directly or indirectly-utilizing other structures.

Component three: the right beam splitter.

Utilized to reflect the center focused video projection onto the right eye of the user and to make the real world visible.

Component four: the left beam splitter.

Utilized to reflect the center focused video projection onto the left eye of the user and to make the real world visible.

Component five: the right overhead display.

To generate the video imagery that will be projected to the right eye of the user.

Component six: the left overhead display.

To generate the video imagery that will be projected to the left eye of the user.

Component seven: the right overhead transparent material plate.

The structure used to hold the right focusing convex lens.

Component eight: the left overhead transparent material plate.

The structure used to hold the left focusing convex lens.

Component nine: the right overhead focusing convex lens.

Utilized to focus the central part of the video projection projected by the right overhead video display.

Component ten: the left overhead focusing convex lens.

Utilized to focus the central part of the video projection projected by the left overhead video display.

Component eleven: the rear side of the surface with markers.

Utilized as geometrical patterns that will act as markers for tracking when this surface (rear surface) is visible to the tracking camera. This surface contains a black and white checkerboard like pattern with a red square shape at the center of the surface.

Component twelve: the right side of the surface with markers.

Utilized as geometrical patterns that will act as markers for tracking when this surface (right surface) is visible to the tracking camera. This surface contains a black and white checkerboard like pattern.

Component thirteen: the left side of the surface with markers.

Utilized as geometrical patterns that will act as markers for tracking when this surface (left surface) is visible to the tracking camera. This surface contains a black and white checkerboard like pattern.

- The components of the back pack.

Component fourteen: the back pack.

The back pack is the structure utilized to house the following components. The components are the mobile computer, the tracking camera, the tracking camera mounting structure and the cable configuration.

Component fifteen: the mobile computer.

Utilized in getting the video data feedback from the tracking camera and generating the video imagery of the virtual vision. This virtual vision would be made visible to the user through the augmented reality headset mounted on the helmet.

Component sixteen: the tracking camera.

Utilized in tracking the head movements (head orientations in three degree of freedom space) of the user through tracking the helmet movements.

Component seventeen: the tracking camera mounting structure.

This structural part is utilized to mount the tracking camera.

Component eighteen: the cable configurations.

This cable configuration connects the mobile computer with the overhead dual display unit and connects the mobile computer with the tracking camera.

Component nineteen: the right shoulder strap.

Utilized in keeping the back pack fasten onto the body over the right side.

Component twenty: the left shoulder strap.

Utilized in keeping the back pack fasten onto the body over the left side.

Component twenty-one: the right waist strap.

Utilized in keeping the back pack fasten onto the body over the below hip level right side.

Component twenty-two: the left waist strap.

Utilized in keeping the back pack fasten onto the body over the below hip level left side.

- The two kinds of axis.

Component twenty-three: the line going through the optical axis of the tracking camera lens.

The positioning of the virtual content surrounding the user is positioned relative to this central axis.

Component twenty-four: the line going through the center axis of the helmet.

- The components of the space surrounding the user.

Component twenty-five:

The blue colored space represents the space surrounding the user where the virtual content are augmented into.

This space is the area to which the available virtual content will be augmented.

Component twenty-six:

The red colored rectangular boarder region represents the binocular overlap region equivalent of the field of view of the average human that will be positioned directly in front of the optical axis of the tracking camera

The area inside this red rectangular boarder region is the average binocular field of view of the average user. This area is greater than the area of the unobstructed view of the real world region (Component twenty-seven).

Component twenty-seven:

The light green colored rectangular region represents the unobstructed view of the real world that will be positioned directly in front of the optical axis of the tracking camera.

This area is smaller than the binocular field of view region. (Component twenty-six). The virtual content that are augmented into the space surrounding the user are excluded from this light green colored rectangular area.

Component twenty-eight:

The center of the unobstructed view of the real world rectangular region.

The general experiences made possible with this system.

1. The user of this system will be able to experience virtual content that are augmented into the space surrounding him or her.
2. These virtual content are of two types. They are text and images.
3. The user will be able to experience these virtual content by orienting his or her head in space relative to the backpack's camera.
4. Right in front of the optical axis of the lens of the camera, will be a rectangular region that is smaller than the binocular field of view of the user.
5. This rectangular region will provide the user with an unobstructed view of the real world. Due to this unobstructed vision, the augmented content will be excluded from this region.
6. The virtual content will be only visible in the region surrounding the user which excludes the before mentioned (that was mentioned in the feature four) rectangular region.
7. In the space where the virtual content are positioned, the virtual content are positioned relative to the central optical axis of the camera lens of the backpack.
8. And this virtual space along with its virtual content, will orient (change their position in 3D space) if the backpack mounted camera orients (change its position in 3D space).
9. This is due to the fact that as mentioned before, in the space where the virtual content are positioned, the virtual content are always positioned relative to the central optical axis of the camera lens of the backpack.
10. Therefore, whenever the user (with this system) displaces from one point in space to another, this virtual space (with the augmented content) will also correspondingly will displace from the old position to the new position in 3D space.

11. This feature (described in experience type ten), will enable the user of this system to experience a collection of virtual content that are augmented into the field of view surrounding him or her that are portable.
12. Also, the user of this system will be able to experience the virtual experience during the process which results in the displacement. This process is the motion which resulted in the displacement.

<u>The experience implementing method.</u>

- The method of how the system tracks the movements of the user's head and thereby generating the corresponding virtual vision is described below.

The system consists of two main mechanisms. They are described below.

Mechanism one: the tracking of the user head movements relative to the back pack mounted tracking camera and the generation of the virtual vision.

The back pack mounted camera which is stationary relative to the back pack and thereby the body, will track the movements of the users head and thereby the helmet movements relative to the camera. This is achieved by the back pack mounted mobile computer getting the frames of the video footages captured by the camera and analyzing them. This video data is transferred from the camera to the mobile computer through the utilization of the cable configuration described as component eighteen in "all the components of the entire system that will provide the portable virtual content experience. The mobile computer will analyze the obtained video footages frame by frame. This analysis process is utilized to determine the changes in the views of the orientations of the geometric patterns of the surfaces with checkerboard like markers as the user orients his or her head to look around the surrounding space. This change analysis will assist the mobile computer in determining the exact direction the user is looking at (gazing at) in any given time. This information about the exact direction the user is looking at will enable the mobile computer to generate the exact corresponding virtual vision the user should see through the augmented reality headset in that direction. The mobile computer upon generating this virtual vision will send that as a video stream to the augmented reality headset to be displayed as a set of projections to the user. This sending process of the video stream is achieved by the utilization of the cable configuration described as component eighteen in “all the components of the entire system that will provide the portable virtual content experience.

Mechanism two: the video projection generation by utilizing the augmented reality headset.

The augmented reality headset, upon receiving the above mentioned video stream (the information containing the virtual vision imagery) described in mechanism one, will execute the following mechanisms to enable the user to experience that virtual vision as a set of projections.

The video stream of the virtual vision will be displayed as a set of video footages by the dual overhead displays labelled as component seven in the side diagram of the helmet with the augmented reality headset fixed to the helmet and as component two and eleven in the front diagram of the augmented reality headset.

These video footages that was displayed by the dual overhead displays will be transformed as a set of central region focused projections by the dual overhead convex focusing lenses labelled as component five in the side diagram of the helmet with the augmented reality headset fixed to the helmet and as component four and nine in the front diagram of the augmented reality headset.

These dual overhead focusing convex lenses are fixed to the dual overhead transparent materials plate labelled as component six in the side diagram of the helmet with the augmented reality headset fixed to the helmet and as component three and ten in the front diagram of the augmented reality headset.

The set of central region focused projections will be reflected off the angled dual beam splitters labelled as component four in the side diagram of the helmet with the augmented reality headset fixed to the helmet and as component six and seven in the front diagram of the augmented reality headset.

This reflected central region focused set of video projections will provide the user of this headset with the virtual vision (of the view in the direction the user is gazing at) where the user could experience the central region of the vision as a clearly focused vision at the same time getting a perception of the vision surrounding the central vision.