From 2D to 3D

Choi, Jongha

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Abstract

The history of the image has always aligned with the history of the human race. In our vast history, it has been understood and depicted in various forms. Nowadays, owing to scientific technology, it is developing in its form, from photography, film and even further towards virtual reality. Even the advent of 3D printing skills shake our fundamental notion of the image. Unlike the past, we are not only seeing the image as a means of reproducing objects, but also giving essential identity to the image itself. In other words, though the image still shows its visual effect on a flat plane, it is not just an expression of representation, but a making real an experience. In our current situation, in which modern society experiences the image, in relation to advertising, image circulation and the internet, why do we not question an images' confinement to a flat surface. Why don't we try to get more stereoscopic and attempt for direct experience with the image. My question started with this point and I tried several experiments in order to realise this idea from a personal point of view.

Introduction

  Since I was young, I have been experiencing a stark difference
in vision of my left and right eyes. I am not so sure whether this
weakness began when I was born, but such gap has grown even more
and now I have to wear a contact lens in my one eye. I remember
when I was a boy that my glasses were always lopsided as one glass
lens was thicker than the other. This discrepant vision has never
been successfully addressed though I continuously visited hospital
to try to cure this handicap. My doctor warned that I will be more
and more dependent on my good eye to see objects and I would not
properly feel perspective in the end. So he actively encouraged me
to get treatment. His warning turned out to be right. I very often
suffered injuries caused by falling from stairs or chin-up bars,
mishaps stemming from my inability to fathom exact distance. I must
confess that my sense of distance is somewhat different from that
of others.

  The image I get in my eyes may not be so distant from taking a
photograph or a movie. It's like having the lens projection of
a light on a flat-surfaced screen. A light refracted through a
lens leaves its mar k as numerous pixels. Likewise, my one eye is
projected on a screen called a retina by way of a lens, my cornea.
All of us can experience distance solely with this flat image. But
technically speaking we understand a given image by resorting to
perspective-based analysis instead of a sense of perspective. This
experience is not identical with a sense of perspective gained from
the subtle difference in the angle of the objects viewed with our
two eyes. We, human measure distance from the disparity of size
or visibility of objects and understand the relationships between
top and bottom and between left and right from what we see or from
sides. Recent 3D screen allows relatively more three-dimensional
effect than before and it is similar to our experience of knowing
an object using our both eyes. But my retina is recognizing

reflection through a single lens, as in the case of conventional photo-taking.

   Let's take an example of a picture with a vanishing point. Even if it is a collection of many lines expressed on this plane, we see the subject three-dimensionally. Its front, side and top side are found on this flat-surfaced picture. A paper illustrates only the front of a surface but we view the picture described on it in a three-dimensional manner. Then we have to ask this question: Why are we seeing it three-dimensionally? This is a very simple question and its answer can easily be derived from a simple perspective formula. Yet I find it interesting to find its actual example in reality. We imagine something that is not expressed in a drawing, besides the simple three-dimension in it.

   Imagine a drawing of a cube. We can easily see a picture describing its front, sides and top. It is a drawing of three squares and each side facing one another. We can easily arrive at its three-dimensional shape although its back side is not visible. This process involves a mechanism of formulating what's lying on the back side of a cube in our head after imagining it on a flat surface. We cannot fully rule out a chance that it is a figure without any rear side or it is a completely unexpected figure, of course. Still we assume a cube.
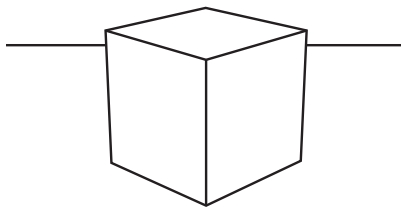
To illustrate my point, let's take an example of a chair, an object that is much closely related to our daily life. Even though a picture of a chair does not show its hind leg, we are aware that one more leg exists, other than the three legs that lie in front of our eyes. Even we can figure out the connection between these legs. This structure is known based on our physical knowledge that a chair can be structurally sustained when it has four legs.
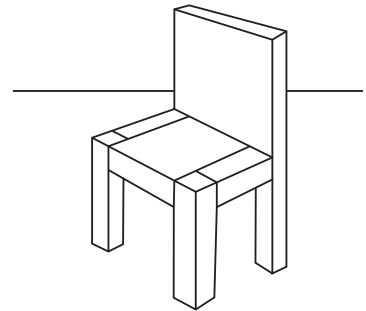
This way of three-dimensional perception of an object may be obtained from our experience. But this experience is not something we can easily get as if drawing a picture on a plane. When we depict a three-dimension on a drawing, we depend on a perspective with a vanishing point and its back space is consequently hidden behind a surface. However, a three dimensional object does not express itself in this fashion in our actual space. Top, bottom, left and right are articulated in a space in our daily lives and sustained at certain lengths and units irrespective of their distances. Such a real spatial experience and its visual interpretation serves as the foundation of our three-dimensional recognition.

In reality, this kind of instances is limitless. When we enter a simple keyword on the Internet, we instantly encounter virtually infinite pictures capturing this word. Such photos offer a good representation of the core features of this subject. We go beyond merely understanding this object and gather its various information, like what sort of structure it has, and how big it is. A picture cannot show it all but it allows a person who is looking at it to recognize the subject in it. This realization becomes clearer when we become a supplier rather than a consumer of this image input. Suppose that a sculptor has to show his creation

resorting only to a single photograph.Then he can choose a picture representing his artwork by taking into account the time and the angle of view that best reveal it. He can make this choice as he is the one who knows his work best and he is aware how his work will be received by its consumer. In other words, this person has the knowledge that others with general experience, including himself, will see and understand his creation based on this photo.

   This idea led me to these series of questions: How come we see an image and an object identically? ; Can we say the image and the object that we believe are the same are actually the same? ; If our perception of an object is not different on a plane image and an actual subject, isn't it possible to substitute the two with each other? ; Isn't it possible to make this substitution when the elements shown on the two media with differing dimensions are not different? ; And if so, which common element of an image and an actual object can be called a core element? It may be impossible to go back and forth between these two medium but one way, which is substituting a three-dimensional subject with a flat-surfaced image and illustrating the outcome in a drawing or a photograph, has already been an established method for a while. The evidence of this is history of painting. Taking a cue from this thought process, can't we find the answer much more easily than we originally believed if we try to understand it the other way round?

   Then we have to ask these questions: Which drawing best describes this element? ; Above all, what is an image? ; What is necessary to substitute this image with a three-dimensional object? ; And we fill the gap with empirical perception when we substitute this three-dimensional object with a plane image. Then what fills the gap if the substitution takes place in reverse?

Image

  History of painting has been the history of human race. It has
been with us for a long time. In the Eastern and the Western
civilizations, a painting is understood as a material to reproduce
and express reality. Drawing technique may vary depending on the
view of the world. Yet the fundamental idea behind a drawing is
that it is the basis of reproducing this world. So in that sense,
this idea is the same anywhere in the world. Drawing method as a
way to represent a subject on a plane piece of paper has evolved in
such a way that it has elevated the standing of its reproduction.
The fundamental origin of a picture is how we put and portray the
essence of a given object on a plane.

  Perspective projection is the most familiar drawing technique
for us, modern humanity. This technique was developed in medieval
Europe. This painting method lets us better experience actuality
because it describes a given subject in the point of view and the
distance we actually have. Perspective projection, a way of

School of Athens_Rafael

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depicting a close object big and clearly while a distant object small and vaguely, is most similar to human being's point of view. This characteristic makes it the most familiar image for human eyes. It is an object-centric painting method, focused on the observer and the object of drawing. Perspective projection is a way of reproducing a certain subject as it is, meaning it is describing this object as it is viewed by its observer.

A painting technique different from above is found in the East. In oriental painting, the main focus was not the scene seen from a person's point of view but the relationship between the object and its surrounding contained in a drawing. Therefore the perspective of an observer in the painting is an image similar to that viewed down from the sky. Even a single subject is painted in a manner different from that in perspective projection. This technique, also called inverse perspective, is what's employed to describe the ideational image of an object. This type of drawing allows expansion of space irrespective of the distances between subjects in this picture, indicating objects can be expressed in this expanded space. So each of the objects, regardless of it is the one lying in the front or in the back, can be arranged within the same extended space. Thus it is an illustration of a collection of multiple points of view, instead of the single fixed point of view of an observer. This reason can explain why we get a sense of difference from the projection of an oriental painting.

Pyeong-Yang Feast_Kim Hong Do

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Another technique is evidenced in ancient Egyptian painting. Ancient Egyptians decided the direction representing each element of a subject and believed that the painting based on this method can deliver the essence of this object. The essence of a subject lies with the frontality they studied, the thinking goes, and the goal of their drawing is to explore and reproduce this essence.

Hunting from a chariot_Ancient Egyptian

As such, there are disparities in painting techniques across civilizations and cultural spheres. Yet the fundamental role of a drawing is searching for and reproducing the essence of this world. This origin of painting may serve as a reason why philosophers determined the quality of a drawing by looking at how well a given painting represented this essence. Plato viewed painting as something inferior, which is chasing the shadow of an essence. He believed that not only a picture but also a symbol, such as a name, showing a specific subject is ultimately originating from the similarity of an object. His thought went on that these symbols can never be the same with a subject because there would be no distinction between original and copied versions. This circumstance is what he found perplexing. Thus he reached a conclusion that we should understand an object, in other words an essence, before a painting or a name. His fundamental and existential point of angle is best captured in this sort of reasoning. For him, the image on a flat surface is not 'the relations between an actual thing and its reproduction' but 'the ties between the byproduct of an

actual thing (an essence) and its reproduction'. So for Plato, the relationship lies between an actual object and the image of its image. It is such a secondary relationship. As can be guessed from his analogy of a cave, the status of an image for him is wholly relevant to its actual figure. We can confirm that this is merely non-essential 'fantasma'.

As above, history of painting goes side by side with the history of human race. Still, its standing is not so solid since its role as a symbol reproducing or indicating a subject goes hand in hand with its fundamental origin. It can be also seen as an obsession of few metaphysical philosophers in the past. In modern days, an object is illustrated in a flat image like an actual form and it is more so than any other time in history. Also science and technology are fully developed in this age. Yet views and theories that similarly distinguish the original and its copy and pursue the original, although they are not fundamentalism, are still influential in our time.

There was a person who viewed a subject from the viewpoint identical to this vantage point in the 20th century. He is Henri Bergson. He saw the standing of an image somewhat differently from Plato and he slightly raised its status through a much extended concept. But a similarity can be drawn with Plato in that he also did not give an image the same qualification as that of an actual being. Bergson claimed that the move, movement and continuity of a subject is something that is part of the essence, not something that must be separated from the essence when we understand the essence of an actual object. His argument goes that the idea of a person is formed through his intellectual thinking and it is ultimately not different from a real thing. He also said that the image in a photograph is the intermediary image of such a continued concept. He thought that it is 'a curse of going in circles around an object driven by a failed, unfilled desire to reach its essence'. To put it in an extreme way, it is too distant from a real subject even if pictures were taken from as many angles as possible. He remarked, "All the pictures of a village taken from every possible

angle can complement among themselves without interfering with each other. But they cannot be the same with this three-dimensional sample complemented and improved by people." Granted, we can tell that there is this undeniable gap between an image and an essence.

A Change of Image

  Yet, we have to question 'what is it like now'. The advancement
of photography in modern times has allowed a very easy and
sophisticated handling of a given image. An image stays with us
as a flat record as it was in the past. Still the difference in
the process and the way of dealing with it results in varying
viewpoints on the image in our contemporary days. A photo is still
the product of a mechanical device that records a subject. But it
offers the representation of an object incomparable with those
in the past. A photo records the state of a subject and even the
spatiality and temporality of the picture. Let me illustrate my
point with a landscape painting. In the past, an artist sketched
his visual experience on a piece of paper and translated it into a
painting on a flat-surfaced canvas, relying on his memory and the
sketch. This method results in a big disparity between what he
wishes to record and what is actually recorded, with respect to
time. Also we cannot rule out the possibility that his personal
experience and subjective view are mixed with the essence of an
object. In contrast, the experience and view of a photographer
accounts just a little, although it cannot be completely removed,
in a photo thanks to its mechanical process. This slight gap that
is left is filled with the existential temporality of a landscape.
Temporary essence of the location, such as weather or light and
shade of the time this photo was taken, touches the surface of a
film, leaving a perpetual afterimage that gives the experience to
its viewer that this time and space is on a standstill. Photos are
produced in a mechanical manner. But instead this feature conveys
them with objectivity and authenticity. Paradoxically photos give
the most certain authenticity in our times, an era characterized by
copy-based image more than any juncture in history.

  Meanwhile this is also becoming thing of the past. It seems the
relationship between an image and an essence is merely a theory

these days. As such, we are already experiencing a crisis of various images. This is because the image we are seeing today transcends the goal of simple reproduction. It touches on our five senses. So it has actuality in itself. The emergence of virtual reality stimulates human senses and makes it possible to gain experience even without the existence of the actual environment. Virtual world means a certain environment or a circumstance that is not a reality but similar to it, which is created using computer-based artificial technology. Such technology, in itself, is also deemed as a virtual world. Here, virtually created environment or situation stimulates its user's senses and allows him with realistic spatial and time experience. He, in turn, can freely cross the border between reality and imagination. Its user can also do more than just be in a virtual reality. He can interact with what's in virtual reality, for instance manipulate or give command using actual devices. The distinction between a virtual reality and a unilaterally realized simulation is that the former enables its user to have interaction and creation of his experience. Examples of virtual reality system we can easily come across are flight training simulation and a game like Second Life which can reflect its user's will.

   Virtual reality can be experienced not only from visual image but also from using a variety of devices and through various senses. Various devices, such as joystick, a data glove, an outfit and a headgear, can maximize its experiential effect. Interaction in a virtual space varies depending on how much this space is similar to our real environment. But if such a space is enforced with all rules in nature, to state it in an extreme manner, then it is reasonable to say that this space is not different from our actual world. It is a space that is identical to reality with realistic spatiality, temporality and entire law of cause and effect.

   The film 'Matrix' depicts this state, relying on a dystopia kind of imagination. This movie about a distant future of the 23rd century treads on the boundary of an extreme virtual reality and an actual world. Its viewers can never forget the shock they

experienced when this movie was first released. It topped the box office and various philosophical ideas presented in the film caught the attention of its audiences,movie

Matrix_the Wachowskis

critics and philosophers. Several books titled 'Philosophy behind Matrix' hit bookshelves. We were shocked at the time with its unexpected yet frighteningly realistic virtual reality we can only get when we draw on our extreme imagination. I may have empathized with the protagonists and even with ordinary people living in a virtual space called Matrix. I felt that everything experienced in this virtual reality is not unlike what I can get in reality. I could not get out of confusion and believed is a space really existing there. The images they see are all delusions but I put myself in a situation where I did not know it. The entire environment they see in there is felt like a space in reality rather than a drawing. What they experienced is practical experience not interaction with illusion. The image of virtual reality is an actual landscape, not a delusion, for them.

  Meanwhile their bodies are kept and grown in an individual incubator-like room located somewhere in an actual space. They are suppressed in a virtual space where their spirit is active but there is no bodily contact. Every sense rules their body. Though they are lying still in their individual rooms, they actually acquire corporeal experience exactly as they get in virtual reality. This is only an imagination in this film, of course. But is this possible? We can compare it with dreaming while sleeping. If we minimize actual corporeal stimulation and concentrate on our dream, the physical stimulation occurring within our dream gives us stimulation as if it is for real.

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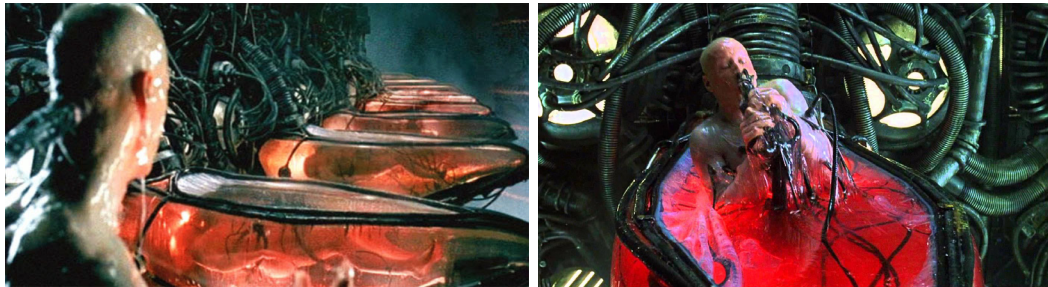
  It has been thought that bodily sense is separate from spiritual realm. Human's physical experience cannot be explained by philosopher's knowledge and it is felt as it is more real than anything else. Thus experience, in itself, is what most certainly distinguishes human nature with other characteristics. However behavioral pattern described in this film and taking place in virtual reality system, which we currently experience in its preliminary form, does no longer make our body something unique about a human being. All we experience within cannot be regarded as 'experiencing' when we see it from a past point of view. Yet in conclusion, we can say that we are actually 'experiencing' it. Spiritual stimulus is enough to give us experience and it can have an essential meaning in itself. This is what is happening in virtual reality.

  Technological progress makes virtual reality much more closely related with reality. Though it is not as in the movie, virtual reality goes beyond forming such relationship and it is having a non-negligible impact on reality. Mixed reality, a go-between of reality and virtual reality, is equally lying on reality and virtual reality. It blends a virtual image with a screen that mirrors reality to show relevant information or have interaction. This experience has already become something that is not noteworthy for a majority of modern people who enjoy smart phones. Mixed reality has already been fully adopted in wide-ranging areas of medicine, culture, education, industry and the like. In Japan, a mixed reality idol singer named Hatsune Miku made debut in 2007. She actually staged a concert performance in front of over 10,000

fans. People went wild with the hologram image shown on the stage. It is also possible to make direct yet simple communication with her.

Concert sight_Hatsune Miku

Image-based world we are experiencing is no longer a copy of reality. It is not an illusion and it forms a world in itself. It coexists with reality and they influence each other. This means that this image-based world is real. It holds a fundamental identity in itself. But it seems this world cannot be separated and become independent from reality. This world does not exist in contrast with reality, as if it is lying across the river we cannot cross. It is coexisting alongside reality. The stature of image today has reached a point of a stark contrast with its standing in the past, due to the development of science.

But what is now evident is that there is a point where virtual reality diverts from reality and this point serving as a connection between them at the same time. There is a limitation that we cannot experience virtual reality without having this point. We make exchanges and gain experience between reality and virtual reality by using a smart phone or other devices. We cannot go into virtual reality we experience without such devices. Smart phone popular among many modern people is a good example. We can see,

move and interact on a screen. But this screen clearly divides
these two spaces with differing characteristics. It is like a sort
of a gateway linking and dividing the two spaces. Technological
advancement may realize a more direct linkage. But we cannot deny
this state we are in now. Today we depend on visual information to
forge an image-based combination of reality and virtual reality.
But what would happen in the future? Can the emergence of a
new device narrow this gap? Though it is hard to tell now, the
existence of a device, no matter how tiny it becomes, does not
allow this gateway-based character to easily vanish. But still we
can imagine, can't we? You never know that a device of a completely
different concept may make intuitive image and actual experience
inseparable. Someday, we may transcend the current visual level and
have physical, sensory and corporeal experience.

To 3D

Recent development of 3D printing technology has been a big issue in our society. All sorts of modifiers are included in the phrases describing a 3D printer. But what is always found is the term 'revolution'. Revolution in production, revolution in manufacturing and revolution in consumption are some of its examples. Some media predicts that this new invention would be more influential than the Internet. Some even made a forecast of the advent of '3D printing era' following this IT age. Almost every day we find articles that it will bring about revolutionary changes in our society and economic activities. Their expectation is that 3D printer will have implications across our society in a broader sense. Also narrowly, they say it will have definite impacts on our individual lives.

Our experience of an image may become different thanks to 3D printing. If we reckon an image as a virtual representation or an ideational being, an image is a channel through which we show this representation or this being in actual reality. It is not about breaking down the barrier between reality and virtual reality. In other words, it is not about creating or piling up a virtual space similar to or reproducing reality. It is rather letting a virtual form to come directly into contact with reality. The direction from reality to image is then turned the other way round.

Today 3D printing technology is not so accessible and it still requires technological improvement. So no magical breakthrough is in sight. But we can anticipate its future and get the image formed in a virtual space. This kind of image does not necessarily be that we have experienced in our real world. We realized our imagined world in this virtual space. Likewise, we can freely turn our imagination into reality in our actual world. It could be the house we want to live in or an imaginary animal. Whatever that is, there is no reason we cannot do it. It may sound like a science

fiction, but a company has already commercialized a 3D printer that can produce edible fruits. Printing can already be made with any material and an artificial organ can be created out of this printer. Against this development, such imagination does not merely appear to be far-fetched.
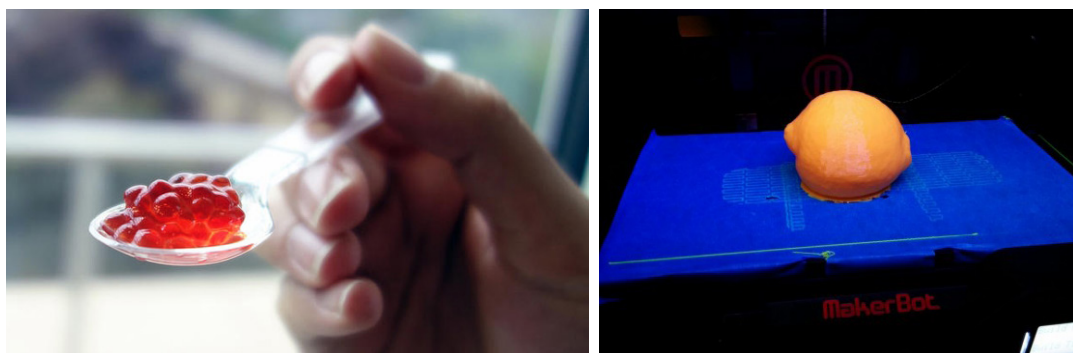
This magical story is about returning the image, which went 'from reality to virtual reality', to 'from virtual reality to reality' and turning it into reality. We see a plane image and feel it intuitively as real. This is because we already know it from our actual experience. Our experience serves as the logical foundation of intuitively processing and analyzing the environment or the object similar to a real thing we see. Converting it back to reality is not an easy job because human's intuitive thought process requires the process of logical analysis and grouping in convertible forms.

This phenomenon was witnessed when computer search system was first invented. It is because the same issue arose when we turned intuitive linguistic use of human being into computer language. Mr. Bergson noted "intuition is single and unique so it agrees with what cannot be described". His insistence tells us that it is not easy to convert intuitive language into symbols and substitute it logically.

   There have been continued attempts to get closer to intuition,
although we may have been using symbolized language. Basic level of
Boolean logic is what is used for computer search functionality.
In his book titled 'How to Look It up Online', Alfred Glossbrenner
describes Boolean logic in simple terms for layman computer
users. Here, 'AND' means that a single record has only two words.
Furthermore, 'OR' indicates that a single record contains either
one of the two terms. 'NOT' connotes that a record cannot have
a specific word. They seem to be easy to understand. But Boolean
logic lies at a special juncture where symbols and logics converge.
Symbolic logic he discovered can group objects with certain
attributes and describe group-to-group relations.

   Mr. Glossbrenner explained Boolean logic using the concept of
Venn diagram we learn in middle school and eased the trouble
computer users experience when they encounter a new search method.
This method involves converting intuitive linguistic habit of human
being into symbols and listing them in a new manner. I can imagine
this method is a logical habit we must definitely acquire anew. So I
understand the difficulty new users would experience. Maybe, young
generation today has taken this experience as granted. Most of what
people now take for granted are what were believed to be amazing
and new. But this search system has already become a habit of our
modern people. There is a criticism that this change negatively
affects people's thought process. Yet what is important is that we
are living in this world armed with a different habit. Our

NOT (OR AND)
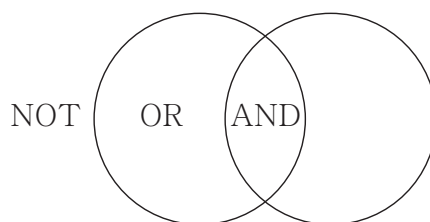
anticipation is that 3D printing technology would have a considerable effect on not only our thought process but also entire aspects. This raises concern but it is also welcoming because it is an encounter with a new world.

  Going back to my original story, another different logic may be necessary to substitute an intuitive image-based world with a logical system, like in the instance of computer search system. Based on our experience, we know that a cube is covered with six sides even if we only see its three sides, and we also know that a soccer ball is round even though we only see its one side. But if we imagine that they alternate between sides and spaces, it is hard to tell now how this can be possible and what kind of process this involves. The notion we have, formed with experience, should be abandoned to some degree, as our physical and materialistic experience must be replaced with an entirely different way if it fails to support this state.

  Our perception of an image has to change as well since an image is no longer a copy reproducing our experience and it becomes an actual being in itself. Conversely, an object lying in a real space becomes a reproduction of this image. Paradoxically, image as our empirical representation becomes the essence in itself. The one-way progress of our idea may go in reverse at one point or our idea can progress in two different directions. Then it leaves a room for a difference between our expected, familiar image and our empirically perceived image.

Experiment

The border between image and reality; and something that transcends it; and such an attempt still appear to be very abstract and something that comes from a science fiction. If so, is there any aspect we can access more practically? I am about to make an attempt from a point that is much more intuitive and physically attainable. I previously mentioned 3D printing technology. Now I wish to try more intuitive 'transformation from an image to a three-dimensional object'. This aim involves translating an image we easily see on a flat surface to a three-dimensional subject. Therefore these two different states of an object - a flat surface and a three dimension – must ultimately have the same function. A chair shown in a photo has to be the one we can sit on and the lamp in a photograph must be a lamp that can really lights the space.

A clue on physical mechanism can be found in a pop-up book, to some extent. When we open a pop-up book, the angle that is formed by two paper sides changes to create a three-dimensional paper form. Technically speaking, this book is not flat when it is folded and closed. It is a three-dimension which is empty and showing only its surface even if it becomes three dimensional. This feature is attributable to the thickness of its papers. But its significance lies in that the magnitude of this change is extremely large. This is true in a sense that its flat-like thickness, though it is not flat and it is empty, presents a three-dimensional subject.

If a material, which is thin and bendable like a paper, is as hard as an iron, we can use it not only for a book we carry around but also for applications on a much bigger scale. Many artists and designers have already substantiated this through their artworks. This mechanism is not unlike that in a pop-up book. So it is easily accessible and its applications in our living environment are already giving us enough inspirations.

A pop-up book more or less allows a physical conversion from
a plane to a three-dimension. Still it is lacking in terms of
intuitive perception because we cannot tell what type of an object
it will show once it is folded and closed. When it is folded, it
has the form of a square-shaped paper folded in half. So it has the
shape of a book as indicated in its term. We cannot predict what
will pop up from inside. This unpredictability is evidently what
makes this book interesting. But my focus would be recognizing an
image as it is and turning it into a three-dimension.
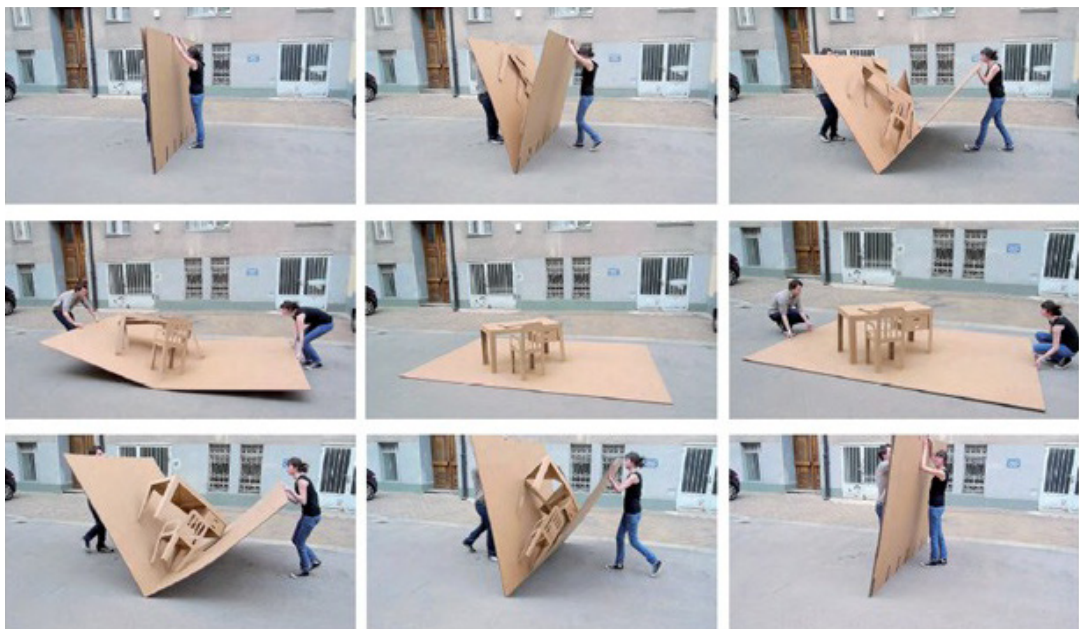
Pop Up_Liddy Scheffknecht and Armin B. Wagner

Thus I began with a flat image. I proceeded with this process
based on an assumption that the flat image we see is an embossing
with a certain thickness. I decided to think this in two
directions: an image created with lines and an image formed with
sides. Both line and side are two-dimensional concepts and they
formed my starting point.

Let's suppose that we move a cube formed with lines from a plane to a three-dimension level. In a three-dimensional space, the sides of six squares are facing one another. In a flat image, one side of each three rhombus must meet with the side of another one rhombus. Additionally, the direction of all sides should be the same in a flat state and a three-dimensional state. Cube's top side has to face upward and its sides must face in a side way. Under this condition, the top side of a cube is transformed from a rectangle into a diamond when only this side is considered. The four angles of a square create 90 degrees and the two angles facing each other must respectively turn into an acute angle and an obtuse angle. All sides of a plane (assuming that the sides of this image are lying in a right angle) are arranged vertically. These lines should be bended in an anterioposterial direction to be located on individually parallel sides, once these lines become three dimensional.
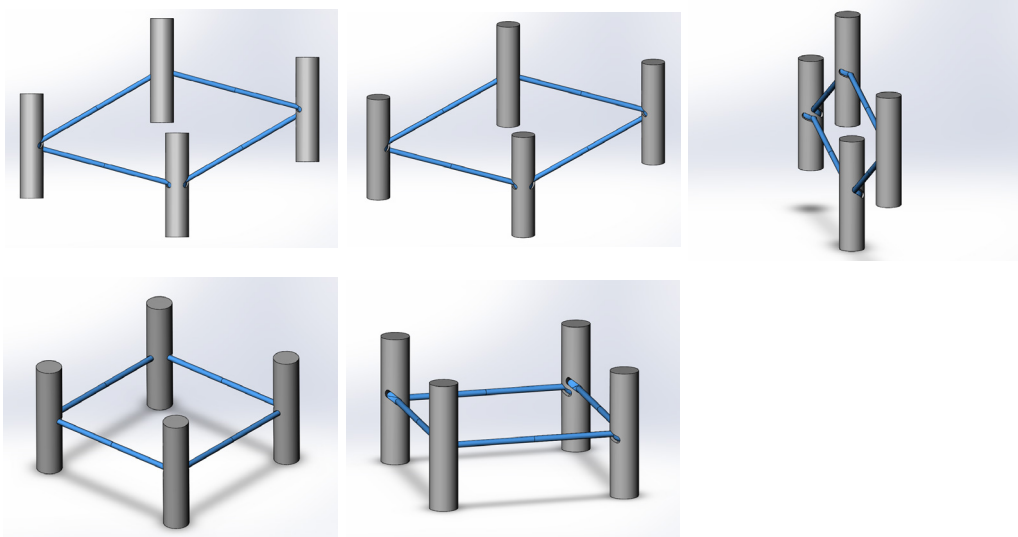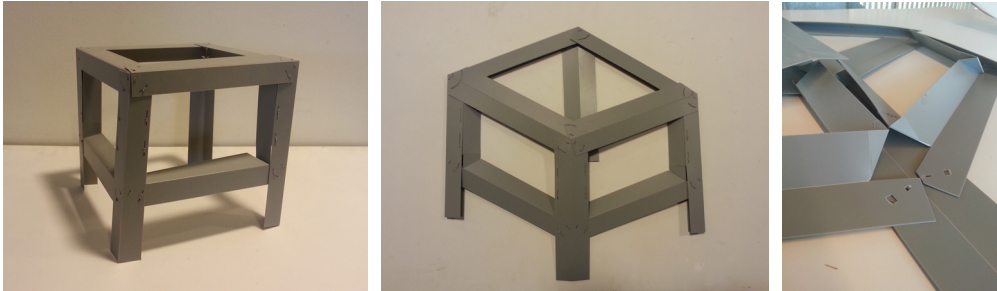
A formation of sides gives rise to another issue. Taking an example of a cube again, we can see three sides on a plane. A cube becomes six sides, adding the rear three sides that were invisible in its plane-wise representation. Each side meets other two sides at each vertex and these sides respectively form a 90-degree angle to face each other in parallel on a plane. Since sides have to be in parallel and three sides have to face each other simultaneously, individual side creates a side with a 120-degree angular point.

The mechanism of image projection is again showing a difference if this method is understood separately as the concept of isometric projection and perspective projection. In the concept of perspective projection, even an identical side may have varying lengths as the length differs depending on the distance between an object and its observer. In that regard, changes not only in an angle but also in length have to be accompanied during the conversion from a plane image to a three-dimensional subject. Meanwhile there is no change in length and change happens only in angle during the shift from three-dimensional to flat representation. This is because the length of each side in the concept of isometric projection is shown in the same ratio as in reality.

These two types of projections can give rise to a possibility of determining the value of an object's elements differently in a given image, depending on viewpoints. Perspective projection grants a sense of perspective and makes it feel like it is real. In contrast, isometric projection does not give confusion, though it

is not as real as perspective projection. This is owing to the fact that the ratio is the same between an actual object and its image. The former is effective when optical illusion-based reality is needed while the latter is better for actual projection.

  Now I feel the need to learn more about the value of isometric projection, a projection technique now popularly employed in mechanical drawing or 3D modeling program. This popularity is explained by its advantages of three-dimensional perception of a given subject and relatively accurate construction. Its disparity with perspective makes it somewhat awkward for us. Yet as can be told from its current usage in 3D modeling, isometric projection can be directly substituted with a three-dimensional object. These days, two different kinds of projection methods like oblique projection and developed projection are employed depending on their purpose of usage. But they are not enough to make us feel they are real. In comparison, isometric projection offers some values when it comes to its intuitive reality. Also it relatively less distorts the information of a given subject. It has strengths in two respects when we intuitively perceive an image and convert it into a three-dimensional state.
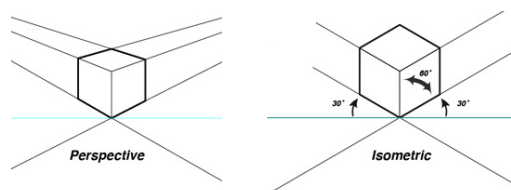
  Is it possible to view it as the aforementioned essential form of an image itself? Can't we even see it as an example of an abstract concept? It would not be a bad try though more attempts and observations would be needed. Its potential is worth exploring since isometric projection is adopted these days in a 3D printing method and in other industrial sites.

Conclusions

  We have always expressed something with an image. Image is not
only a means required for reproducing reality, but also a means
for expressing human's imagination. From Lascaux cave paintings
to fabuous creatures, human have described even things we could
not grasp the truth by means of image. Beyond just expressing,
modern technology is helping us to experience at a level that
almost conforms with reality. We are passing through the era that
only experience on the screen. It means it is not limited to
our imagination anymore. But rather the imagination instigates
technology. As we are facing what only remained in the imagination
10 years ago, our imagination can lead us to what we cannot
predict.

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From 2D to 3D