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Enforceability of Machine Patents in Virtual Worlds

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Computer simulations of physical phenomena are not new and have been used for at least 60 years.[1] Continuing technological developments, however, have significantly altered the character of these simulations. With the development of massively multiplayer online role-playing games (MMORPGs) employing 3D graphics in the late 1990s[2] and three-dimensional virtual worlds such as Second Life in the early 2000s,[3] computer simulation has become part of mainstream culture and a significant part of the real-world economy.[4]

The interplay between virtual worlds and intellectual property has been receiving increasing attention, not only in the media but also academically and professionally.[5] Most of the attention to date has dealt with intellectual property in the form of copyright and trademark and the rights of end-user creators who produce user-generated content within these worlds.[6] This article addresses the related, although conceptually very different, issue of infringement of real-world patents through the making, using, offering for sale, and selling of virtual objects within virtual worlds such as Second Life. The implications of this issue extend beyond virtual worlds and impact all forms of computer simulation.

The fundamental question to be addressed is as follows: Given a real-world patent (we are going to limit our scope to machine patents for the purposes of this paper), would it be infringement of that patent to, in a virtual world, make, use, offer to sell or sell a virtual machine, which, if it were a real-world machine, would be infringing? Although the question is straightforward to state and to understand, answering it draws in difficult technical issues, such as understanding the nature of simulation and its relation to the physical world, and complexities of patent infringement, including inducing infringement, the doctrine of equivalents, contributory infringement, calculation of damages, and, in certain circumstances, may require consideration of the impact of foreign activity (particularly if any part of the virtual world is hosted on servers outside of the United States or when transactions involve parties located outside the United States). This article explores these issues, drawing conclusions about the conditions under which infringement might be reasonably established and measures that may be taken by inventors to protect their innovations from use within virtual worlds and introduces related issues which might warrant further consideration.

A virtual world is "a computer-generated, three-dimensional representation of a setting in which the user of the technology perceives [themself] to be[,] and within which interaction takes place."[7] There are an increasing number of virtual

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worlds available online, with more users signing up for them every day.[8] One that has particularly attracted attention in the media is Second Life, which was opened to the public in 2003 and currently has more than 13 million registered avatars.[9] At first glance, it may seem that Second Life is just a big videogame, and one might wonder why anyone should care; however, Second Life has its own virtual currency (Lindens or L$), which residents can use to buy and sell goods and services in the virtual world and for which there is an active exchange where they can be traded for US dollars. The current exchange rate is around $1 US = L$265,[10] and in 2007 residents spent between $20 and $35 million (US) per month.[11] The GDP of Second Life in 2007 was estimated between $500 and $600 million,[12] putting it at about the same level as the Caribbean island of Grenada.[13] It is not surprising then that Second Life has been getting increasing attention in the media, from the business world, and from lawyers. In fact, a number of law firms have opened virtual offices in Second Life,[14] and a Second Life Patent and Trademark Office has been established (although it is no longer active).[15]

The level of engagement fostered by the semi-realistic graphical presentation of virtual worlds fosters consideration that, perhaps, these are separate worlds of some sort, where real-world laws should not apply. In fact, one of the earliest virtual worlds, LambdaMOO (which was entirely text-based), developed a basic form of law and self-government.[16] Although such musings can make for interesting cocktail-party conversations, they have failed to gain any foothold of serious consideration. Although a virtual world can certainly create its own laws and self-government, either democratically as LambdaMOO did or through the imposition of a terms of service agreement, as with most virtual worlds such as Second Life, the inescapable fact is that, behind it all, there are real people interacting, and a virtual world is, when you look underneath the impressive graphics, nothing more than another means of communication between human beings. When items are bought and sold, they are bought and sold by people. When inventions are used, they are used by people. If crimes are committed, they are committed by people against other people. Any laws and self-government that might exist in a virtual world are simply contractual arrangements between users, enforceable only through real-world laws. The legal considerations are considerable because of the abstract nature of the property involved, the international nature of the transactions, and the additional level of abstraction resulting from the use of avatars as a means of personal interaction, but it is still real-world laws that apply to the people who interact with each other through the medium of a virtual world. These laws will certainly need to adapt, as they do for many advances in technology,[17] but they still apply.

In particular, laws relating to intellectual property apply within Second Life, and these issues have been getting substantial attention, particularly as related to copyright and trademark law.[18] In this article, we consider a related issue, but one that has received less attention, and that is the applicability of real-world patents to virtual world machines. Addressing this issue brings in a range of technical and legal issues, so we will review some of the pertinent background first.

TECHNICAL ISSUES: SIMULATION AND VIRTUAL WORLDS

Virtual worlds are based on computer simulations of the real world. Computer simulation is "the technique of representing the real world by a computer program; 'a simulation should imitate the internal processes and not merely the results of the thing being simulated.'"[19] In order to do this, objects are represented by computerized abstract descriptions. These abstract descriptions are referred to as models. For example, a person might be represented as being made up of a head, a body, two legs, and two arms. There would be additional information maintained, such as the name, its location in the simulated world, its orientation (*i.e.*, which way it is facing), what objects it might be carrying, etc. Each of the parts would be further broken down, for example a leg might be represented as being made up of an upper leg, a lower leg, and a foot. The leg would also have a position, orientation, etc. Non-human objects are represented in the same fashion. When users are logged on to the virtual world, they see visual representations based on the collection of models that exist within the virtual world. This visual representation is computed using standard three-dimensional graphics techniques, taking into consideration the models for all of the objects that are within the user's view to give the user a reasonably realistic view of the virtual world.

With the objects in the world represented as models in this way, the simulation proceeds by:

1. Obtaining input from the users of the virtual world who are controlling the avatars;[20]
2. Performing calculations that simulate changes that would occur under the same circumstances in the real world, taking into account interactions between objects and physical laws such as gravity, friction and momentum; and then
3. Updating the models of objects in the virtual world to reflect those changes.

With the models updated, the system will then compute a new visual representation, which would reflect any changes that have occurred. This cycle of input-update-display occurs repeatedly, ideally many times per second, in order to give a realistic impression of the virtual world.

For example, if an avatar were holding onto an object, and the person controlling it gave a command that it should drop it, then the simulation would calculate how far the object would fall, and then update its position accordingly. This cycle of calculation-update would continue to modify the position of the object until it hit the ground, at which time the object might break or bounce, for example, depending on the results of the calculations performed by the simulation as the result of the impact of the object with the ground. These calculations are performed repeatedly, updating the state of the world many times per second, and the visual representation provided to the user is updated similarly, giving the impression of continuous motion and change as the object drops to the ground in the virtual world, just as we would observe in the real world.

Although simulations such as that carried out in Second Life do not need to follow the same physical rules as the real world, they generally do, and as a result, virtual objects in a virtual world will exhibit behaviours analogous to the behaviours of their real counterparts in the real world.[21] Stated differently, virtual worlds such as Second Life often strive to simulate real-world physics as accurately as possible.

One of the things that makes virtual world simulations so interesting and engaging is the three-dimensional graphics used to depict the virtual world in a way that is very similar to the way that we perceive the real world.[22] It is not in any way essential that a computer simulation provide such depictions, and, in fact, many uses of computer simulation simply provide numerical results, which then may require significant effort in interpretation to understand their meaning. For example, in one of the earliest uses of computer simulation, the process of nuclear detonation was modelled by computer as part of the Manhattan Project in World War II in designing the atomic bomb.[23] The output from these simulations would have been numbers representing various factors predicted by the simulation that the scientists would interpret in order to predict what the results would have been if the simulated experiments had actually been carried out.

Another complicating factor when it comes to virtual worlds is that, as with anything else on the Internet, it is difficult to determine where (in the real world) an activity is occurring. Depending on the locations of servers and the computers being used by the participants in the world, different parts of the computer operations that determine the behaviour of the virtual world could be taking place in a number of different places in the real world, and the models representing the objects in the virtual world could also be stored in computer memory in vastly disparate geographical locations. In fact, because of the way that these systems work, there will generally be multiple copies of the model for a particular virtual object stored in various computers, perhaps scattered across many countries. In order to focus the analysis in this article, we will assume that all activity of interest takes place only in the United States. We will mention some of the issues relating to the territorial aspects of this issue in the concluding paragraphs.

LEGAL ISSUES

Patentable inventions include "any new and useful process, machine, manufacture, or composition of matter."[24] Although the applicability of patents relating to processes, manufactures, and compositions of matter in virtual worlds is certainly worthy of discussion, in order to keep the scope of this article manageable, we will limit our attention to patents relating to machines, but we will nonetheless mention some of the issues relating to other forms of patent claims in the concluding paragraphs.

DIRECT INFRINGEMENT

The basic rule of infringement is as follows: "Except as otherwise provided in this title, whoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States, or imports into the United States any patented invention during the term of the patent therefor, infringes the patent."[25]

The question at the root of the issue addressed by this article is that of determining whether a simulation of a patented invention in a virtual world would be considered an infringement of a patented invention under § 271(a).

Note that § 271(a) does not give the court guidance in determining what constitutes "the patented invention,"[26] but, in the last 150 years, it has been established that the claims of the patent are of primary importance in determining infringement. This was stated unequivocally in *Merrill v. Yeomans*:

> The act of Congress therefore very wisely requires of the applicant a distinct and specific statement of what he claims to be new and to be his invention. . . . This distinct and formal claim is therefore of primary importance in the effort to ascertain precisely what it is that is patented to the appellant in this case.[27]

In construing the claims, the court looks foremost to so-called intrinsic evidence, that is the patent's specification and prosecution history (including the prior art of record).[28] In the absence of a special or unique use of a claim term in the specification, the ordinary meaning to one skilled in the art controls.[29]

The Federal Circuit has made clear that it is proper to consider extrinsic evidence, such as expert testimony, only in limited circumstances and for limited purposes: "In most situations, an analysis of the intrinsic evidence alone will resolve any ambiguity in a disputed claim term. In such circumstances, it is improper to rely on extrinsic evidence. . . ."

> No doubt there will be instances in which intrinsic evidence is insufficient to enable the court to determine the meaning of the asserted claims, and in those instances, extrinsic evidence, such as [the expert testimony] relied on by the district court, may also properly be relied on to understand the technology and to construe the claims. . . . However, as we have recently re-emphasized, extrinsic evidence in general, and expert testimony in particular, may be used only to help the court come to the proper understanding of the claims; it may not be used to vary or contradict the claim language. Nor may it contradict the import of other parts of the specification.[30]

The Federal Circuit has distinguished between different types of extrinsic evidence. Regarding inventor testimony, the court has made clear that "the inventor's subjective intent as to claim scope, when unexpressed in the patent documents" is of no effect.[31] Technical treatises and dictionaries fall within a special category of extrinsic evidence:

> Judges are free to consult such resources at any time in order to better understand the underlying technology and may also rely on dictionary definitions when construing claim terms, so long as the dictionary definition does not contradict any definition found in or ascertained by a reading of the patent documents.[32]

In *K-2 Corp*, the Federal Circuit stressed further the importance of the ordinary and accustomed meaning of disputed claim terms.

> [T]he ordinary and accustomed meaning of a disputed claim term is presumed to be the correct one, subject to the following. First, a different meaning *clearly and deliberately* set forth in the intrinsic materials—the written description or the prosecution history—will control. Second, if the ordinary and accustomed meaning of a disputed term would deprive the claim of clarity, then further reference must be made to the intrinsic—or in some cases, extrinsic—evidence to ascertain the proper meaning. In either case, *a party wishing to alter the meaning of a clear claim term must overcome the presumption that the ordinary and accustomed meaning is the proper one, demonstrating why such an alteration is required.*[33]

It is well settled that "[d]etermining whether a patent claim has been infringed requires a two-step

analysis: First, the claim must be properly construed to determine its scope and meaning, as discussed above. Second, the claim as properly construed must be compared to the accused device or process."[34]

After having construed the claims at issue, a court then considers whether those claims read on that which is accused of infringement.[35] To establish infringement of a patent claim, the patent holder must show the presence of every element (or step) or its substantial equivalent in the accused device (or method). If the presence of every claimed element is shown, there is literal infringement. In the absence of one or more elements, infringement may nonetheless be shown under the doctrine of equivalents, but only if there exists a substitute for the missing element(s) that differs insubstantially, for example, performs substantially the same function in substantially the same way to obtain substantially the same result.[36]

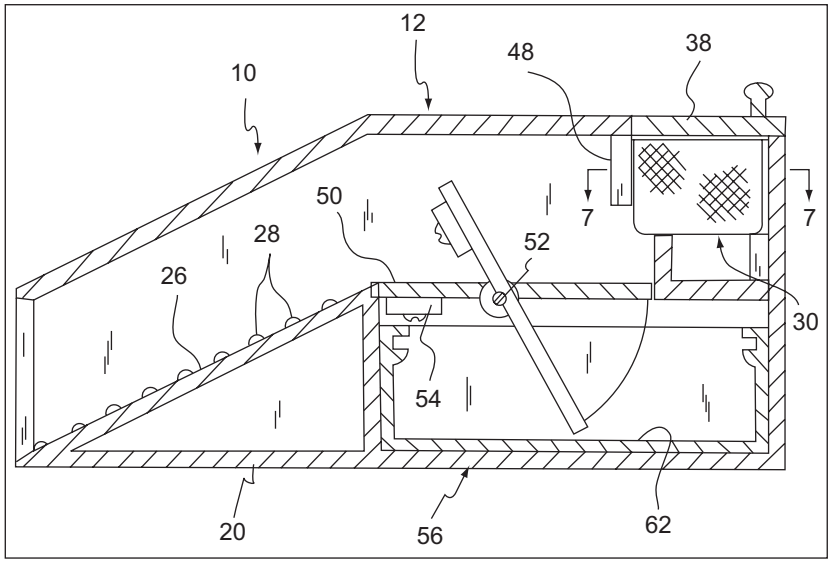
Application of the doctrine of equivalents may also be limited by prosecution history estoppel. For example, arguments distinguishing the claimed invention over prior art indicate what the claims do not cover and thus, by implication, indicate a surrender of that subject matter.[37] Similarly, narrowing claim amendments made to satisfy any requirement of the Patent Act may give rise to an estoppel.[38] Such narrowing amendments result in a presumption of estoppel barring application of the doctrine of equivalents to cover "the territory between the original claim and the amended claim."[39]

Throughout this article we will use as an illustrative example a patent on a better mousetrap illustrated in Figure 1.[40]

The trap is described as being made up of a main body (12), a ramp (26), a bait container (30), a trapdoor (50), and a holding compartment (56) (among other parts). In operation, the mouse enters the main body, walks up the ramp, trying to access the bait, steps onto the trapdoor, which drops open and deposits the mouse into the holding container. It would be straightforward to create an exact virtual copy of such a device in a virtual world such as Second Life, and it would function in the simulation in the same way as a real version of the mousetrap, conceivably capturing virtual mice. Some might question the utility of capturing virtual mice, but it should be remembered that utility is not an aspect of infringement. Rather, it is the utility of the invention itself that is material to patentability and not the utility of the allegedly infringing use.[41] For our purposes, we will assume that the patent meets the validity requirements in the real world, and we will focus our discussion on infringement.

As will be discussed later, it is uncertain whether a virtual version of a machine would be found to directly satisfy the claims of a patent directed at a physical machine. Thus we will need to consider the application of the doctrine of equivalents. Furthermore, it may be difficult to establish that someone who builds and sells (but does not directly use) a model of a virtual mousetrap in a virtual world is, in fact, infringing, since the model is simply an abstract, computerized representation used in the simulation. A model in a virtual world can be compared to a kit containing raw materials and instructions for constructing an infringing object. Creating and selling such a kit is not a direct infringement, but it may be indirect infringement. Similarly, a model in a virtual world is a collection

Figure 1: Better Mousetrap



of data and computer instructions that, when constructed in the virtual world, creates a virtual object that may infringe. Thus it will be necessary to consider aspects of indirect infringement in our analysis.

Judge Learned Hand characterized the doctrine of equivalents as follows: "[A]fter all aids to interpretation have been exhausted, and the scope of the claims has been enlarged as far as the words can be stretched, on proper occasions courts make them cover more than their meaning will bear."[42]

The doctrine exists because, if the courts were to insist on literal infringement, it would be possible to evade patent infringement, but still profit from the patent-holder's innovation, by making insubstantial changes to a patented invention. For literal infringement to exist, every element of a claim of the patent must be literally present in the product.[43] For example, in our mousetrap patent, it is indicated in Claim 1 that the "holding compartment extends through side walls of said main body and includes a drawer slidably received therewithin."[44] A modification as simple as having the drawer be "rotatably" instead of "slidably" received could result in a device that does not literally infringe the patent but that would be profiting inappropriately from the original inventor's innovation. A maker of an insubstantially modified version of the patented invention would thus be able to effectively interfere with the patent holder's monopoly rights without fear of reprisal. The doctrine of equivalents is not limited to situations such as this, where there is deliberate and intentional evasion of a known patent, but rather applies in the same way as infringement in general where the knowledge or intention of the accused infringer is irrelevant, as stated in *Warner*: "Application of the doctrine of equivalents, therefore, is akin to determining literal infringement, and neither requires proof of intent."[45]

The doctrine is based on the theory that, "if two devices do the same work in substantially the same way, and accomplish substantially the same result, they are the same, even though they differ in name, form or shape."[46] This foundation is the basis for one generally accepted test for equivalence: the function-way-result test. It is important to note that the test of equivalence is not applied to a claim as a whole, but rather must be applied element-by-element, as explained in *Warner*:

> Each element contained in a patent claim is deemed material to defining the scope of the patented invention, and thus the doctrine of equivalents must be applied to individual elements of the claim, not to the invention as a whole.[47]

Thus, under the function-way-result test, to determine whether a virtual mousetrap infringes the patent, each element of the claims must be examined to determine whether the virtual mousetrap performs substantially the same function, in substantially the same way, and accomplishes substantially the same result as the real mousetrap described in the claims of the patent.

The courts have also applied the insubstantial differences test, sometimes in conjunction with the function-way-result test. Under this test, "an accused product or process, to avoid infringement under the doctrine, must include 'substantial and not merely colorable' differences from the patent claims."[48] An all-elements test also applies, requiring that every element of a claim be present, either literally or equivalently, in order for there to be a finding of infringement.[49] The all-elements test can also be thought of as a limitation on the doctrine of equivalents, and there are other limitations that have been established as well.[50]

INDIRECT INFRINGEMENT

Mark Lemley characterizes indirect infringement as follows: "The goal of secondary liability is to give patent owners effective protection in circumstances in which the actual infringer either is not the truly responsible party or is impractical to sue."[51] This concept is codified as follows:

> (b) Whoever actively induces infringement of a patent shall be liable as an infringer.
>
> (c) Whoever offers to sell or sells within the United States or imports into the United States a component of a patented machine, manufacture, combination, or composition, or a material or apparatus for use in practicing a patented process, constituting a material part of the invention, knowing the same to be especially made or especially adapted for use in an infringement of such patent, and not a staple article or commodity of commerce suitable for

substantial non-infringing use, shall be liable as a contributory infringer.[52]

It is settled law that, in order for there to be a finding of indirect infringement, there must be a direct infringement upon which this is based: "Of course, a finding of induced or contributory infringement must be predicated on a direct infringement."[53] Presuming that such a direct infringement is found, there are different requirements imposed by § 271(b) and (c). These requirements fall into two general categories: what sort of activity constitutes indirect infringement and what knowledge requirements must be met in order to find liability.

INDIRECTLY INFRINGING ACTIVITIES: CONTRIBUTORY INFRINGEMENT

The sort of activity that is to be captured under contributory infringement is clearly specified in § 271(c). This has been summarized as follows: "Section 271(c) applies only where a person has (1) sold, offered for sale or imported (2) nonstaple articles especially made or adapted for infringing a patent."[54] Note that, even if an article has significant infringing uses, it does not fall within the reach of § 271(c) if it also has substantial non-infringing uses.[55] The scope of activities that constitutes contributory infringement is narrowly constructed to ensure that legitimate businesses do not fall within this scope inadvertently, and it is only those manufacturers that are directly encroaching on the patent holder's monopoly that are captured within it. As explained by Lemley, "the law must take … care to avoid imposing liability on those who participate in the stream of lawful commerce merely because their products can be misused."[56]

INDUCING INFRINGEMENT

What constitutes inducing infringement is not, however, clearly spelled out. It has been described as being "as broad as the range of actions by which one in fact causes, or urges, or encourages, or aids another to infringe a patent."[57] Lemley suggests three possible interpretations of the case law:

(1) inducement is limited to causing infringement on a respondeat superior theory;
(2) inducement extends beyond causing infringement to include efforts to cause infringement, such as urging or encouraging infringement by another; and
(3) inducement includes anything a defendant does to help a third party to infringe.[58]

Most of the cases fall within (1) or (2), requiring at a minimum some sort of encouragement to infringe on the part of the defendant. Lemley summarizes this as follows: "Many courts will find liability on the basis of something less than control over the infringer, but most stop short of saying that any act that aids an infringer can be inducement."[59]

Qualifying these characterizations of what constitutes inducing infringement is the requirement that there be some positive action on the part of the alleged infringer: "Of course inducement has connotations of active steps knowingly taken—knowingly at least in the sense of purposeful, intentional, as distinguished from accidental or inadvertent."[60]

Some of the sorts of activities that have been found to constitute inducing infringement are:

1. Providing instructions, which, if followed, would result in infringement;[61]
2. Advertising or promoting the use of a product in an infringing manner;[62]
3. Providing indemnification against infringement damages;[63] and
4. Supplying or selling a product, knowing it will be used in an infringing manner.[64]

KNOWLEDGE REQUIREMENTS

Direct patent infringement is a strict liability offense.[65] Indirect infringement, however, is not: "Indirect infringement, by contrast, has always required some element of knowledge. This requirement probably derives from the common law origin of indirect infringement in accessory liability, which requires that the defendant know that the behavior she aids is wrongful."[66]

CONTRIBUTORY INFRINGEMENT

Knowledge is explicitly required under § 271(c) for a finding of contributory infringement. The knowledge requirement here is specific, but easily met, requiring "a showing that the alleged contributory

infringer knew that the combination for which his component was especially designed was both patented and infringing."[67] Once this knowledge requirement is met, liability will be found. The courts have even indicated that a good faith belief that the product was not infringing is not a defense: "All that is required for a finding of contributory infringement is (1) knowledge of the activity that is alleged to be infringing . . . and (2) knowledge of the patent."[68] As discussed earlier, the activity captured under contributory infringement is narrowly defined to ensure that only those intending to encroach on the patent will be within the scope of § 271(c). Thus the knowledge requirement is broadly structured. This is in contrast to inducing infringement, in which the range of activities captured is broad, but the knowledge requirement has been narrowly interpreted by the court.

INDUCING INFRINGEMENT

In contrast to contributory infringement, there is no explicit knowledge requirement for inducing infringement in § 271(b), but the courts have found that some level of knowledge is required: "Thus, a person infringes by actively and knowingly aiding and abetting another's direct infringement. Although section 271(b) does not use the word "knowing," the case law and legislative history uniformly assert such a requirement."[69]

However, this intent does not have to be explicit and can be inferred from the circumstances. The courts, however, have been less than consistent in deciding the type of knowledge that is required. At one end of the spectrum it is suggested that all that is necessary is "proof of actual intent to cause the acts which constitute the infringement,"[70] while at the other end it is necessary that the alleged infringer "knew or should have known his actions would induce actual infringements."[71] This inconsistency was addressed, and the inconsistency clarified, by the Court of Appeals for the Federal Circuit in 2006: "The requirement that the alleged infringer knew or should have known his actions would induce actual infringement necessarily includes the requirement that he or she knew of the patent."[72]

This is unequivocal in the unqualified requirement for knowledge of the patent, regardless of the level of involvement in the direct infringement. In fact, the court went even further than just requiring knowledge of the patent, indicating that:

> In order to induce infringement, there must first be an act of direct infringement and proof that the defendant knowingly induced infringement with the intent to encourage the infringement. The defendant must have intended to cause the acts that constitute the direct infringement and must have known or should have known [that] its action would cause the direct infringement.[73]

This sets an extremely high bar for knowledge and intent with respect to inducing infringement, requiring, in all cases, not only knowledge of the patent but also knowledge (or constructive knowledge) that direct infringement would result.

ANALYSIS

We will now consider the following question: Given a real-world patent on a machine of some sort (using the mousetrap patent as an example), would it be infringement of that patent to, in a virtual world, make, use, offer to sell, or sell a virtual machine, which, if it were a real-world machine would be infringing (using a direct virtual copy of the trap in the patent as an example)? We will illustrate this consideration using the mousetrap patent discussed previously, looking specifically at Claim 1:

> 1. A mouse trap comprising:
>
> a main body having a front wall including an entrance opening which permits access by a mouse to an interior of said main body;
>
> a ramp extending from said entrance opening at an oblique angle relative to a bottom wall of said main body to a position spaced above said bottom wall;
>
> a bait container removably positioned within said interior of said main body proximal to a rear wall thereof;
>
> a trapdoor pivotally mounted within said main body, said trapdoor including an adjustably mounted counter weight which serves to gravitationally bias said trapdoor into a substantially

> horizontal orientation engaged to an upper end of said ramp; and,
>
> a holding compartment positioned beneath said trapdoor, wherein said trapdoor, upon receiving a weight of said mouse onto a portion of said trapdoor will rotate to deposit said mouse within said holding compartment
>
> wherein said holding compartment extends through side walls of said main body and includes a drawer slidably received therewithin; and further comprising screen means for selectively closing an upper opening of said drawer.[74]

The first step in an infringement analysis is to construe the claims. This includes determining whether the main body, ramp, bail container, trapdoor, and holding compartment include virtual representations of these otherwise physical features. Once the claims are construed, the second step is to compare the construed claims to the allegedly infringing device.

Patent claims are interpreted according to their ordinary and customary meaning,[75] and "the ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention."[76] Of course, the patentee could define the terms of the patent to include virtual versions of the physical objects described, but that has not been general practice (although perhaps it should be). It therefore appears likely that claim construction would depend on whether the patentee included support in the specification for reading the claims on simulations, virtual versions, or other computerized representations of the machine or apparatus.

We next consider whether the virtual mousetrap would satisfy the claims of the patent. Because it is created based directly on the patent, there are corresponding elements in the virtual mousetrap for each element of the claim. However, it seems questionable whether direct infringement would be found in a case such as this where the claims of the patent describe physical parts of a mechanical device and the allegedly infringing device is a virtual item. It could certainly be argued, and likely successfully, that a virtual mousetrap does not have a "trapdoor," a "main body," or any of the other physical parts described based on the ordinary meaning of those terms to someone skilled in the area of rodent-catching devices in 1995.[77] Even if the patent were issued today, it is uncertain whether direct infringement would be found. If one were to ask someone skilled in the art of rodent-catching machines, while pointing at a virtual rendition of this mousetrap on a computer screen, "Is that a trapdoor?" (or main body, or whatever), the answer would likely be something like, "well, not really" or "no, it's just a picture of one." Assuming that the specification of the patent does not indicate otherwise, the parts referred to in the claims would appear to refer to physical objects, and their virtual representations are clearly not physical objects. The specification of the mousetrap patent, for example, states that: "An even further object of the present invention is to provide a new mousetrap which is susceptible of a low cost of manufacture with regard to both materials and labor."[78] It is clear that the inventor intended the patent to cover physical parts. It would seem, therefore, that the holder of the mousetrap patent would have to rely on the doctrine of equivalents to establish infringement in a virtual world.

APPLICATION OF THE DOCTRINE OF EQUIVALENTS

As the virtual mousetrap is a direct copy of the mousetrap from the specification of the patent, there is no question about the presence of all the elements of the claim. The only question is simply whether the virtual versions of the elements are equivalent to the physical versions. We consider the trapdoor, looking particularly at the fifth element of the claim as an illustrative example: "a holding compartment positioned beneath said trapdoor, wherein said trapdoor, upon receiving a weight of said mouse onto a portion of said trapdoor will rotate to deposit said mouse within said holding compartment"[79]

There are two particular aspects of the doctrine of equivalents that would need to be balanced in order to determine if the trapdoor in the virtual mousetrap is equivalent to the trapdoor described in the patent. The first is the aspect of interchangeability. As stated in *Graver Tank*, "[a]n important factor is whether persons reasonably skilled in the art would have known of the interchangeability of an ingredient not contained in the patent with one that was."[80] Clearly, the virtual trapdoor would not be

interchangeable with the physical trapdoor. However, this requirement for interchangeability does not rule out the possibility of equivalence between abstract entities and physical entities. For example, hardware and software implementations of similar functionality have been found to be equivalent: "Indeed, we have upheld determinations of equivalence on the ground that hardware and software implementations of a component of an invention are interchangeable substitutes."[81]

The second aspect is the role of technological advances in consideration under the doctrine of equivalents. The Federal Circuit has specifically stated that the results of technological changes occurring post-grant can be captured as equivalents:

> [T]his court [has] held that variations in the invention, made possible by subsequent advances in the art, do not allow the accused infringing device to escape the "web of infringement." An appropriate range of equivalents may extend to post-invention advances in the art in an appropriate case.[82]

Particularly because, in this case, the variations in the invention as a result of the advances in technology are related to the form of the invention and not its function, this aspect of the doctrine of equivalents would likely work in favor of the holder of the mousetrap patent.

The court's handling of these two aspects of equivalency would suggest that the distinction between a virtual machine and physical machine should not be a determinative factor in considering infringement under the doctrine of equivalents. If we consider the function-way-result test, the Supreme Court has indicated that it is the functionality of the elements that should be considered, not their particular form:

> Except where form is of the essence of the invention, it has but little weight in the decision of such an issue, the correct rule being that, in determining the question of infringement, the court or jury … are to look at the machines or their several devices or elements in the light of what they do, or what office or function they perform, and how they perform it.[83]

This stance has been reiterated much more recently in *Warner*:

> An analysis of the role played by each element in the context of the specific patent claim will thus inform the inquiry as to whether a substitute element matches the function, way, and result of the claimed element, or whether the substitute element plays a role substantially different from the claimed element.[84]

Returning to the trapdoor in our virtual mousetrap, its function or role is to lie in wait until an unsuspecting mouse walks onto it, and then rotate under the weight of the mouse, dropping the hapless creature into a holding compartment. One could argue that whether the mouse is virtual or physical and whether the force of gravity is applied physically or through mathematical computations in a computer simulation are issues relating to form and not function and thus should not be considered in an equivalents analysis. The virtual trapdoor therefore has substantially the same function performed in substantially the same way to accomplish substantially the same result. Similarly, the other parts of the virtual mousetrap would likely be found to satisfy the function-way-result test, performing substantially the same function in substantially the same way to obtain the same result.

A finding that an accused product satisfies the function-way-result test is not necessarily determinative of the doctrine of equivalents issue,[85] and in fact, "a finding of infringement under the doctrine of equivalents requires proof of insubstantial differences between the claimed and accused products or processes."[86] However, given that the differences relate to form, rather than function, and the court's determination that physical and abstract manifestations of the same thing can be equivalent, combined with the allowance for extension under equivalents to new technologies, it would not be surprising if a court were to find that the virtual mousetrap infringes the mousetrap patent under the doctrine of equivalents and, more generally, that real world machine patents can read on virtual renditions of those machines. However, in view of the fundamental difference between the physical and virtual versions of the mousetrap (one catches an *actual* mouse, the

other does not), it would be equally unsurprising if a court were to hold that, absent clear language in the specification to the contrary, a physical machine or apparatus cannot read on a virtual representation of that machine or apparatus.

MAKING, USING, OR SELLING

Assuming *arguendo* that the mousetrap patent is found to read on the virtual mousetrap, we need to consider when infringement actually occurs. Recall, as discussed earlier, that a computer model of a virtual object is analogous to a kit containing raw materials and instructions for constructing an infringing object from the raw materials. Just as the production of such a kit would not constitute direct infringement, so would production of the computer model of the virtual mousetrap not constitute direct infringement. Thus it is necessary for us to consider when the actual infringing article, the virtual mousetrap, was made, used, or sold.[87]

Supposing that it is the producer of the virtual mousetrap that the patent owner would wish to sue, then the use of the mousetrap is of little interest, as that is done only by the individual users of the trap.[88] Establishing that the producer of the virtual mousetrap made or sold them directly may be difficult. What is being made or sold is a description of a virtual mousetrap (the kit of raw materials and instructions) that is used to create a virtual mousetrap at the instigation of the end user and is not a virtual mousetrap itself.[89] When a user purchases something in a virtual world such as Second Life, this is accomplished, for example, by right-clicking on a sign advertising the product and the selecting "buy" from the menu that appears. After agreeing to the purchase price, the specified amount of the Second Life currency is transferred from the purchaser's account to the seller's account, and a copy of the product is then added to the user's inventory list. The effect of this is to add a model of the product to the representation of the user's avatar (as an item that this avatar now owns), so it is really this model, this abstract description of a virtual mousetrap, that has been sold to the user and not an actual virtual mousetrap. The user can then place the product in the virtual world, and at this point the virtual representation is created (the kit is used to construct the infringing article) and displayed based on the model of the product.

This is analogous to selling a kit of parts accompanied by instructions describing how to assemble them into an infringing article. In this sort of situation it is the end user who is making and using the infringing device, and the person selling the kit has little direct infringement of the patent other than when developing, creating, and testing the kit, because no infringing article has otherwise been made, sold, or used.[90] The Federal Circuit has clearly stated that "one may not be held liable under § 271(a) for 'making' or 'selling' less than a complete invention."[91] Given the strong stance that the Federal Circuit has taken on this position, it seems unlikely that the sale of a computerized, abstract representation of a virtual mousetrap would be considered the sale of a virtual mousetrap.[92] Since there is little point in suing the end users of the virtual mousetraps for infringement, in order to pursue the maker and seller of the virtual mousetrap the patent holder may be able to rely on indirect infringement, either as inducing or contributory infringement.

CONTRIBUTORY INFRINGEMENT

There is little doubt that the sale of virtual mousetraps would constitute the sale of "nonstaple articles especially made or adapted for infringing a patent"[93] as required by § 271(c). There is no use for the article sold other than creating an infringing virtual mousetrap. However, the knowledge requirement would likely, in most cases, be more difficult to establish. Infringement would be found only if it could be established that the producer of the virtual mousetrap knew that it was both patented and infringing. In our hypothetical case, where the virtual mousetrap was copied directly from the patent, it could certainly be established, but, more generally, people do not usually produce products when they know of a patent that reads on the article, so contributory infringement would largely be limited to use for compelling an infringer to stop production of the infringing article upon notice of the patent.[94]

INDUCING INFRINGEMENT

The test applied to determine inducing infringement is described as follows:

> To prove the first part of the test—that a defendant by his conduct "induced infringing acts"—the patentee must show:

(1) a third party committed an act of direct infringement; and
(2) the defendant undertook an affirmative act during the enforceable term of the patent, and not merely a failure to act, that induced, aided or abetted the act that directly infringed the patent (the "inducing act").

To prove the second part of the test, that the defendant "knew or should have knownhis actions would induce actual infringements," the patentee must show that the defendant:

(1) had actual or constructive knowledge of the asserted patent at the time it committed the inducing act;
(2) knew or should have known that the acts of the third party it encouraged by its inducing act would result in direct infringement; and
(3) had a specific and "actual intent to cause the acts which constitute the infringement" by its inducing act.[95]

Presuming *arguendo* that the direct infringement would be established under the doctrine of equivalents, the first aspect of the first part is established. Furthermore, it seems certain that the sale of the model of the virtual mousetrap would constitute a direct act satisfying the second aspect of the first part of the test.[96] The second part of the test is more difficult to meet, however, requiring not only knowledge of the patent but also "intent to encourage the infringement."[97] In our mousetrap example, it is likely that this part of the test could also be met. Given that the virtual mousetrap is directly copied from the patent, knowledge of the patent is clear. Given this knowledge, the producer of the virtual trap would also know that, when someone purchased a model of the virtual trap, direct infringement would occur when the user created the virtual mousetrap from that model. Furthermore, again by the sale of the model, the producer would clearly intend that the purchaser would create a virtual mousetrap from this model, thus establishing the intent to cause the act constituting infringement.

Without knowledge of the patent, however, the second part of the test could not be established, and inducing infringement would be of the same limited use to the patent holder as contributory infringement in compelling an infringer to stop production of the infringing article upon notice of the patent, as discussed in the previous section with respect to contributory infringement.

Alternatively, if the court were to retreat from the high bar set in *DSU* and take on an approach more in line with Lemley's suggestion that the level of knowledge and intent required be inversely proportional to the directness of the involvement of the accused inducer in the direct infringement,[98] then there is a chance that the virtual mousetrap producer could be found liable for inducing infringement. There would be no question that the producer of the virtual mousetrap would know and intend that the purchaser of the mousetrap model would use it to create a virtual mousetrap. If the standard from *DSU* were relaxed so as not to require knowledge of the patent in cases with such direct involvement, then inducing infringement could be used in cases such as these to allow the patent holder to collect damages for sales prior to having received notice of the patent. However, given the clear wording in *DSU*, this seems unlikely.

RESULTS

Based on this analysis, we can conclude that the prospects of the holder of the mousetrap patent being able to successfully sue the producer of a virtual version of the mousetrap for sales of the trap are not good, unless knowledge of the patent can be established. On the other hand, the patent holder would most likely be successful if notification were made to the virtual mousetrap producer and the producer continued to sell virtual mousetraps, either under inducing or contributory infringement. As a result, a patent on a real-world machine could be used to prevent future infringements on the patent holder's rights, but would probably not be useful in getting compensation for past infringements. There is, however, one remaining avenue that could be available to the patent holder.

USE DURING DEVELOPMENT AND TESTING

The one possibility that would be open to the patent holder would be to establish that the producer of the virtual mousetrap made and used these virtual mousetraps directly (during development and testing, for example), and, but for this infringement, the producer would not have been able to sell the virtual

mousetraps, and the patent holder would have made these sales instead.

> The general rule for determining the actual damages to a patentee that is itself producing the patented item, is to determine the sales and profits lost to the patentee because of the infringement. . . .
>
> In order to recover lost profits a patentee must show a reasonable probability that, but for the infringement, it would have made the sales that were made by the infringer.[99]

Note, however, that this rule applies only when the patent holder is producing the patented item. In our hypothetical situation, although the patent holder may well be producing real mousetraps, if he is not producing virtual mousetraps, then he would not be able to establish that, but for the infringement, he would have made those sales himself. Without the ability to prove lost profits, the patent holder would, however, still be entitled to damages that represent a reasonable royalty.

> Upon finding for the claimant the court shall award the claimant damages adequate to compensate for the infringement but in no event less than a reasonable royalty for the use made of the invention by the infringer, together with interest and costs as fixed by the court.[100]

Given that, in this scenario, the direct infringement by the producer of the virtual mousetrap is limited to making and use of the patented invention during design and testing of the virtual mousetrap, one might expect that such royalties would be negligible, because of the small number of infringing articles made and used by the virtual mousetrap producer. However, the reasonable royalty is based on a hypothetical negotiation between the parties and not simply calculated based on the number of infringing articles involved.

> A reasonable royalty calculation envisions and ascertains the results of a hypothetical negotiation between the patentee and the infringer at a time before the infringing activity began. Thus, the reasonable royalty calculus assesses the relevant market as it would have developed before and absent the infringing activity.[101]

This hypothetical negotiation takes into account a wide range of factors, including the downstream use of patented articles:

> [W]hen determining what royalty a manufacturer would reasonably be willing to pay, the parties should account for the fact that the manufacturer would know of the use the downstream user would make of the product, the value of that use to the downstream user, and how the downstream user's value would impact how the manufacturer would value the technology in its decision on whether to license.[102]

In certain circumstances, the value of sales of unpatented products is also taken into consideration: "Where a hypothetical licensee would have anticipated an increase in sales of collateral unpatented items because of the patented device, the patentee should be compensated accordingly."[103]

Given the range and flexibility of the factors taken into account when considering this hypothetical negotiation, the holder of the mousetrap patent may well be able to collect reasonable damages for past production of the virtual mousetraps, if the essential use of the invention during the development process can be established.

RECOMMENDATIONS

Given the uncertainty over the availability of patent protection for virtual versions of patented machines in the preceding analysis, it is important to consider what might be done when drafting a patent to enhance the probability of being able to assert that patent in a virtual world.

One thing that would enhance this probability would be to eliminate the reliance on the doctrine of equivalents by including claims that read specifically on virtual versions of the machine, referring, for example, to computer representations of each of the elements. This might be done by explicitly discussing an embodiment in a virtual world or at least indicating that each element might comprise physical structure

or might be simulated via computer in a virtual world or other graphically rendered simulation.

At the same time, one would ideally want to draft the claims in such a way that they capture the model of the virtual machine, and not just the representation of it in the virtual world, in order to be able to protect the sale of the model, thus supporting protection through direct infringement against the producer/seller of the virtual machine and eliminating the reliance on indirect infringement or the use of the invention in development and testing in order to establish liability. The difficulty with this would be in ensuring that the resulting claims would be found to be patentable subject matter. A model of a machine in a virtual world is reasonably analogous to software code. They are both intangible, abstract representations. The difference is that software code represents a process, and a virtual model represents a device. In either case, they would not, by themselves, be patentable subject matter.[104] The virtual model is, in essence, a data structure,[105] which is non-patentable subject matter when claimed in the abstract. "[D]ata structures and computer programs which impart functionality when employed as a computer component . . . are nonstatutory when claimed as descriptive material per se."[106] One way of dealing with this difficulty would be to write the claims as process claims or as apparatus claims including, for example, computer memory, as part of the apparatus. How this approach would be framed, and its potential for success, would depend very much on the outcome of the pending appeal of *In re Bilski*.[107] However, even if they can be applied successfully, the problem with these approaches is that they do not capture the sale of the virtual model, but only the use, as it is the end user who carries out the process, and the end user who completes the apparatus by creating the representation of the virtual model in the virtual world. Similar concerns exist in the patenting of software-related inventions, and one response to this has been the development of what are known as *Beauregard* claims. They are so named because, in 1994 in response to an appeal by Gary Beauregard of a rejection of a patent application involving software, the PTO changed its rules regarding the patentability of software.[108] As a result, computer software and data structures, when they are stored on a computer-readable medium, are described as being patentable subject matter in the MPEP: "When functional descriptive material is recorded on some computer-readable medium, it becomes structurally and functionally interrelated to the medium and will be statutory in most cases since use of technology permits the function of the descriptive material to be realized."[109]

It should be noted that the court's decision in *Beauregard* was a procedural one only, and it did not rule on the substantive issue of the patentability of software or data structures when stored on a computer-readable medium. In fact, Iancu and Helm argue that the patentability of *Beauregard* claims is far from certain.[110] In any case, the use of *Beauregard* claims would not be particularly helpful in the situation that we are considering. *Beauregard* claims would protect software and data structures when stored on a computer-readable medium, and it is the sale of this combination on the media (*e.g.*, CD, DVD) that would be protected directly. When a model is sold in a virtual world, there is no computer-readable medium involved in the sale. This situation is analogous to the sale of software for download on the Internet (rather than on some form of media), which is not protected by a *Beauregard* claim. What is being sold in this sort of situation is, in essence, a signal, and the question of the ability to cover the sale of signals by patent protection appears, at this point, to have been answered in the negative: "Nuijten and the PTO agree that the claims include physical but transitory forms of signal transmission . . . We hold that such transitory embodiments are not directed to statutory subject matter."[111]

It would appear that the prospects of being able to protect a model using a signal claim are poor, at least without legislative intervention.

CONCLUSIONS

As can be seen in the preceding analysis, the difficulties in establishing patent protection for virtual machines are, not surprisingly, intimately intertwined with issues relating to patent protection for software and data structures. Although holders of patents of mechanical devices may be able to expect patent protection within virtual worlds, it would be advisable, if such protection is desired, to draft claims specifically to enable such protection, as well as to include support in the specification for reading the claims on virtual embodiments of the machines described in the patent. Even with specific claims, it is uncertain what level of protection would be available. The

extension of the foregoing analysis to process claims would probably be straightforward, as carrying out a process in a virtual world is just a particular variant of computerization of that process, although when the outputs of the process are physical things (as opposed to information), then the matter would be more complicated. How this could be extended to claims relating to manufacture or composition of matter is not at all clear. Things are not generally manufactured in a virtual world (they simply appear as the result of the execution of some computer instructions), and it is difficult to imagine what a virtual composition of matter would be or what it might be useful for.

Another issue that should be considered, and was briefly mentioned in this article, is that of territoriality and jurisdiction. For any given virtual object, there may be multiple models stored in computers scattered across the globe. Transactions between users and interactions between objects regularly span international borders. Given the subtleties of the patent law when components of inventions cross international borders, these issues will require careful consideration.

Additionally, it would be interesting to examine the potential liability of the operators of a virtual world with respect to indirect infringement. Especially if they received notification of the existence of a patent, if that patent were infringed within the virtual world, would there be a risk of liability? Of course, complicating this even further are the licenses and terms of service associated with virtual worlds, which sometimes go as far as requiring a user of the system to waive all patent rights within the virtual world when signing up for the service.[112] Until the validity of such terms is determined, inventors who wish to protect their inventions against use within virtual worlds would be well advised to carefully read any agreements before signing up for such services.

One other issue, which could have far-reaching practical impact, is the application of the analysis presented here to computer simulations other than in virtual worlds. For example, airplane manufacturers use simulation techniques extensively in designing aircraft. If these simulations involve the simulation of any patented inventions, it would be important to ensure that appropriate licensing is worked out before the simulation is constructed, keeping in mind that a license that covers a physical device might not cover virtual representations of that device.

NOTES

1. *See* computer simulation at *http://en.wikipedia.org/wiki/Computer_simulation*.
2. *See* massively multiplayer online game, *http://en.wikipedia.org/wiki/Massively_multiplayer_online_game*.
3. *See* Second Life, *http://en.wikipedia.org/wiki/Second_Life*.
4. Although a general discussion of the economy of virtual worlds such as Second Life is beyond the scope of this article, it is important to realise that there is a significant and growing real economy, including an active exchange of the Second Life currency and US dollars.
5. Issues relating to virtual property (personal property held inside a virtual world, including virtual real estate) have also arisen. *See, e.g.*, "Second Life Land Deal Goes Sour," *Wired*, *http://www.wired.com/gaming/virtualworlds/news/2006/05/70909*.
6. *See, e.g.*, "Legal Issues that Impact Virtual Worlds," *Virtually Blind*, *http://virtuallyblind.com*.
7. Webster's New Millennium Dictionary of English (Preview Ed. (v 0.9.7)), "virtual environment," *http://dictionary.reference.com/browse/virtual environment*.
8. James H. Burnett III, "More real people are leading virtual lives," *Miami Herald*, May 15, 2007.
9. An avatar is a representation of a user in a virtual world. Most of the time they are in the form of a human character, but this is not always so. The number of avatars would be more than the number of individual human users, as some people will have more than one avatar. Also, note that not all of these users are necessarily active, but there were more than 1 million separate residents logged in during February and March 2008, *http://|secondlife.com/whatis/economy_stats.php*.
10. *http://secondlife.com/whatis/economy-market.php*.
11. *http://secondlife.com/whatis/economy-graphs.php*.
12. *http://en.wikipedia.org/wiki/Linden_dollar*.
13. *http://en.wikipedia.org/wiki/List_of_countries_by_GDP_(nominal)*.
14. "First UK law firm opens 'virtual' office in Second Life," *http://business.timesonline.co.uk/tol/business/law/article1699474.ece*.
15. *http://www.slpto.com/*.
16. *http://en.wikipedia.org/wiki/LambdaMOO*.
17. Consider, as a simple example, the changes in law as the result of the introduction of instantaneous forms of communication over distance such as the telex and telephone as illustrated by Entores Ltd. v. Miles Far East Corp., [1955] 2 QB 327.
18. *See, e.g.*, the range of posts at *http://virtuallyblind.com/category/virtual-law/copyright/ and http://virtuallyblind.com/category/virtual-law/trademark/*.
19. WordNet® 3.0 (Princeton University), "computer simulation," *http://dictionary.reference.com/browse/computer simulation*.
20. An alternative way of thinking of avatars is to think of them as models that represent characters in the virtual world (generally, but not always, human characters) and that are controlled by a human user.
21. It may be interesting to consider what might happen if, for example, gravity were turned off in Second Life or even made to work backwards, pushing objects away from the virtual Earth. In fact, Second Life does allow for certain departures from physical laws in that, for example, people have the ability to fly and to teleport instantaneously from one location to another.
22. One might argue that the depictions in Second Life are far from photo-realistic graphics, having a cartoon-like character, but they are engaging enough to attract the numbers of users as discussed above.
23. *http://en.wikipedia.org/wiki/Computer_simulation*.
24. 35 U.S.C. § 101.

25. 35 U.S.C. § 271(a).
26. *See* Robert Patrick Merges and John Fitzgerald Duffy, Patent Law and Policy: Cases and Materials (4th ed. (LexisNexis 2007)) at 782.
27. Merrill v. Yeomans, 94 U.S. 568 (1876).
28. Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1582-1584 (Fed. Cir. 1996). Extrinsic evidence on the meaning of claim terms, such as inventor and expert testimony, is only properly relied upon in the event that there is still some genuine ambiguity in the claims after consideration of all available intrinsic evidence. *Id.* The *Vitronics* case was cited with approval extensively in the Federal Circuit's more recent *en banc* ruling addressing claim construction, Phillips v. AWH Corp., 415 F.3d 1303 (Fed. Cir. 2005). *Phillips* endorses an approach which "focuses at the outset on how the patentee used the claim term in the claims, specification, and prosecution history, rather than starting with a broad [dictionary] definition and whittling it down." *Id.* at 1321. "In *Vitronics*, we did not attempt to provide a rigid algorithm for claim construction, but simply attempted to explain why, in general, certain types of evidence are more valuable than others. Today, we adhere to that approach and reaffirm the approach to claim construction outlined in that case . . . ." *Id.* at 1324.
29. *Id.* at 1582; *see also* Ekchian v. The Home Depot, Inc., 104 F.3d 1299 (Fed. Cir. 1997) (quoting Carrol Touch, Inc. v. Electro Mechanical Sys., Inc., 15 F.3d 1573, 1576 (Fed. Cir. 1993)).
30. *Carrol Touch*, 15 F.3d at 1583-1584.
31. *Carrol Touch*, 15 F.3d at 1584.
32. *Carrol Touch*, 15 F.3d 1584 n.6.
33. K-2 Corp. v. Salomon S.A., 191 F.3d at 1362-1363 (citations omitted) (emphasis added).
34. Ekchian v. The Home Depot, Inc., 104 F.3d 1299, 1302 (Fed. Cir. 1997) (quoting Carrol Touch, Inc. v. Electro Mechanical Sys., Inc., 15 F.3d 1573, 1576 (Fed. Cir. 1993)); *see also* K-2 Corp. v. Salomon S.A., 191 F.3d 1356, 1362 (Fed. Cir. 1999).
35. Digital Biometrics, Inc. v. Identix, Inc., 149 F.3d 1335, 1348 (Fed. Cir. 1998); Markman v. Westview Instruments, Inc., 52 F.3d 967, 976 (Fed. Cir. 1995) (*en banc*), *aff'd*, 517 U.S. 370 (1996).
36. *See* Warner Jenkinson Co. v. Hilton Davis Chemical Co., 520 U.S. 17, 39-40 (1997).
37. *Ekchian*, 104 F.3d at 1304.
38. Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd., 535 U.S. 722, 736 (2002).
39. *Festo*, 535 U.S. 722 at 740.
40. Figure 3 from "A trap for capturing mice or other rodents," US Patent No. 5,471,781 (Dec. 5, 1995) (the mousetrap patent).
41. Although the utility of the infringing use may have an impact on the measure of damages. Furthermore, the simple fact that someone purchases the virtual trap suggests that there is some form of utility, at least in the mind of the purchaser.
42. Royal Typewriter Co. v. Remington Rand, Inc., 168 F.2d 69 (2d Cir. 1948).
43. London v. Carson Pirie Scott & Co., 946 F.2d 1534, 1538-1539 (Fed. Cir. 1991).
44. The mousetrap patent, *supra* n.40, col, 4, line 52.
45. *Warner*, 520 U.S. 17 at 35.
46. Graver Tank & Mfg. Co. v. Linde Air Products Co., 339 U.S. 605 (1950).
47. *Warner*, 520 U.S. 17 at 29.
48. Hilton Davis Chemical Co. v. Warner-Jenkinson Co., Inc. 62 F.3d 1512, 1517 (Fed. Cir. 1995).
49. *Warner*, 520 U.S. 17 at 29.
50. The primary limitations are: (1) The doctrine of equivalents will not be used to expand a claim to the point that it would have been excluded from patentability due to "prior art." (2) The doctrine cannot be used to gain patent protection of something that was disclosed in the patent but not claimed. (3) Prosecution history estoppel limits the application of the doctrine of equivalents based on representations made during the patent prosecution process in order to get the patent granted. None of these limitations are of interest in the context of this article, although some of them, particularly prosecution history estoppel, have been the subject of significant academic debate.
51. Mark A. Lemley, "Inducing Patent Infringement," 39 *U.C. Davis L. Rev.* 225, 228 (2005).
52. 35 U.S.C. § 271.
53. C.R. Bard, Inc. v. Advanced Cardiovascular Systems, Inc. 911 F.2d 670, 673 (Fed. Cir. 1990).
54. Merges, *supra* n.26, at 919 n.1.
55. *Bard*, 911 F.2d at 674-675.
56. Lemley, *supra* n.51, at 228.
57. Fromberg, Inc. v. Thornhill, 315 F.2d 407, 411 (5th Cir.1963).
58. Lemley, *supra* n.51, at 339.
59. Lemley, *supra* n.51, at 231.
60. *Fromberg*, 315 F.2d at 411.
61. Golden Blount, Inc. v. Robert H. Peterson Co., 438 F.3d 1354, 1362-1363 (Fed. Cir. 2006).
62. Chiuminatta Concrete Concepts, Inc. v. Cardinal Industries, Inc., 145 F.3d 1303, 1312 (Fed. Cir. 1998).
63. H.B. Fuller Co. v. National Starch and Chemical Corp., 689 F. Supp. 923, 945 (D. Minn. 1988).
64. nCube Corp. v. Seachange Intern., Inc., 436 F.3d 1317, 1324-1325 (Fed. Cir. 2006).
65. *See* Blair v. Westinghouse Elec. Corp., 291 F. Supp. 664, 670 (DDC 1968). "[A]n infringement may be entirely inadvertent and unintentional and without knowledge of the patent."
66. Lemley, *supra* n.51 at 236.
67. Aro Mfg. Co., Inc. v. Convertible Top Co., 377 U.S. 476, 488 (1964) (emphasis added).
68. Sandisk Corp. v. Lexar Media, Inc., 91 F. Supp. 2d 1327, 1335 (N.D. Cal. 2000).
69. Water Technologies Corp. v. Calco, Ltd., 850 F.2d 660, 668 (Fed. Cir. 1988).
70. Hewlett-Packard Co. v. Bausch & Lomb Inc., 909 F.2d 1464, 1469 (Fed. Cir. 1990).
71. Manville Sales Corp. v. Paramount Sys., Inc., 917 F.2d 544, 553 (Fed. Cir. 1990).
72. DSU Medical Corp. v. JMS Co., Ltd., 471 F.3d 1293, 1304 (Fed. Cir. 2006).
73. *DSU*, 471 F.3d at 1305 (emphasis added).
74. The mousetrap patent, *supra* n.40, col. 4, line 33.
75. *Phillips*, 415 F.3d at 1312.
76. *Phillips*, 415 F.3d at 1313.
77. Recall that virtual worlds such as Second Life didn't really become generally available until the late 1990s and were not commonplace until into the 2000s. This also is an example of how the filing date of a patent might play an important role in determining whether a virtual implementation infringes the patent or not.
78. The mousetrap patent, *supra* n.40, col. 2, line 10.
79. The mousetrap patent, *supra* n.40, col. 4, line 48.
80. *Graver Tank*, 339 U.S. at 338.
81. Interactive Pictures Corp. v. Infinite Pictures, Inc. 274 F.3d 1371, 1383 (Fed. Cir. 2001).

82. American Hosp. Supply Corp. v. Travenol Laboratories, Inc. 745 F.2d 1, 9 (Fed. Cir. 1984).
83. Union Paper-Bag Mach. Co. v. Murphy, 97 U.S. 120, 125 (1877).
84. *Warner*, 520 U.S. at 40.
85. Roton Barrier, Inc. v. Stanley Works, 79 F.3d 1112, 1126 (Fed. Cir. 1996).
86. *Hilton Davis*, 62 F.3d at 1521.
87. Or offered for sale, but the issues with respect to that are the same as for sale.
88. Although, if there is no other way to establish infringement by the producer of the virtual mousetrap, one could argue that the virtual trap must have been used by the producer in developing and testing it, and, if not for those uses, then none of the sales of the virtual trap could have occurred. Based on that argument the patent owner could claim the profits made by the producer for all sales of the virtual trap. We will return to this argument later.
89. As defined earlier, what the virtual mousetrap producer actually sells is a model of a virtual mousetrap, which is an abstract, computerized representation. The function of this model is its use in creating representations of virtual mousetraps, and this would not be considered equivalent to a physical mousetrap, even under a liberal application of the doctrine of equivalents.
90. Although the argument regarding use, *supra* n.81, also applies to making the infringing product.
91. Rotec Industries, Inc. v. Mitsubishi Corp. 215 F.3d 1246 (Fed. Cir. 2000).
92. For example, in Deepsouth Packing Co. v. Laitram Corp. 406 U.S. 518, 528, the Supreme Court indicated that "We cannot endorse the view that the 'substantial manufacture of the constituent parts of (a) machine' constitutes direct infringement when we have so often held that a combination patent protects only against the operable assembly of the whole and not the manufacture of its parts."
93. Merges, *supra* n.26.
94. Or suing for damages based on continuing infringement after notification. Note that a subjective belief that the article is not infringing is no defense. An opinion of counsel indicating non-infringement, may, however, work as a defense.
95. Robert A. Matthews, Jr., Annotated Patent Digest (Thomson West 2005, updated Mar. 2008) § 10:35.
96. *See* Oak Industries, Inc. v. Zenith Electronics Corp., 726 F. Supp. 1525, 1541-1542 (N.D. Ill. 1989) indicating that even the sale of staple articles could constitute inducement, as long as the other aspects were met.
97. *DSU*, 471 F.3d at 1305.
98. Lemley, *supra* n.51 at 226.
99. Del Mar Avionics, Inc. v. Quinton Instrument Co. 836 F.2d 1320, 1326 (Fed. Cir. 1987).
100. 35 U.S.C. § 284.
101. Integra Lifesciences I, Ltd. v. Merck KGaA, 331 F.3d 860, 869-870 (Fed. Cir. 2003).
102. Matthews, *supra* n.95, §30:97, referring to Stickle v. Heublein, Inc., 716 F.2d 1550, 1562 (Fed. Cir. 1983).
103. TWM Mfg. Co., Inc. v. Dura Corp., 789 F.2d 895, 901 (Fed. Cir. 1986).
104. Diamond v. Diehr, 450 U.S. 175, 185 (1981) (laws of nature, natural phenomena, and abstract ideas are excluded from patent protection).
105. For a thorough discussion of data structures and patentability, *see, e.g.*, Andrew J. Hollander, "Patenting Computer Data Structures: The Ghost, the Machine and the Federal Circuit" (2003) *Duke L. & Tech. Rev.* 33.
106. US Patent & Trademark Office, Manual of Patenting Examining Procedure § 2106.01 (Sept. 2007).
107. In re Bilski, 545 F.3d 943 (Fed. Cir. 2008).
108. In re Beauregard, 53 F.3d 1583 (Fed. Cir. 1995).
109. MPEP, *supra* n.106, § 2106.1.
110. Andrei Iancu and Jeremiah Helm, "Code on Disks and Hat Tricks—Is Computer Software on a Medium Really Patentable?," 90 *J. Pat. & Trademark Off. Soc'y* 97 (2008).
111. In re Nuijten 500 F.3d 1346, 1353 (Fed. Cir. 2007).
112. *http://secondlife.com/corporate/tos.php*. *See*, in particular, § 3.2.

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