



PATENTS ACT 1977

APPLICANT Imagination Technologies Limited

ISSUE Whether patent application GB1808323.8 complies
with section 1(2)(c) of the Patents Act 1977

HEARING OFFICER J Pullen

DECISION

Introduction

- 1 Patent application number GB1808323.8 entitled “Implementing Traditional Computer Vision Algorithms As Neural Networks” was filed on 25 May 2018 and it was published as GB 2574372 A on 11 December 2019.
- 2 On 14 December 2018 the examiner issued a combined search and examination report setting out an objection that the invention was excluded from patent protection as a program for a computer as such, contrary to section 1(2)(c), and an objection that the invention lacked an inventive step contrary to section 1(1)(b). Subsequently, there followed several rounds of communication between the examiner and the applicant’s attorney. While the inventive step objection was resolved, no agreement was reached in respect of the excluded matter objection.
- 3 In the final examination report dated 11 September 2020, which also serves as the pre-hearing report, the examiner offered the applicant the opportunity to be heard by a hearing officer in order to decide the excluded matter objection. The offer was accepted in the attorney’s letter of 8 January 2021.
- 4 The matter came before me at a hearing on 24 March 2021 where the applicant was represented by Nikki Davy of Slingsby Partners LLP and Dan Cooney of Imagination Technologies. Prior to the hearing the applicant included with their attorney’s letter of 17 March 2021 a skeleton argument, for which I am extremely grateful, and a proposed set of amended claims for consideration at the hearing. At the hearing Ms Davy asked that my decision should be based on this proposed set of claims. These amended claims were duly filed, following the hearing.
- 5 The only matter before me is whether the application is excluded as a program for a computer as such. As the pre-hearing report notes, the update of the original search has not yet been completed. If I find in favour of the applicant, then the application will have to be remitted back to the examiner for further processing and for the search to be completed.

The invention

- 6 The application explains at paragraph [0048] that many computer systems run so-called traditional computer vision algorithms which allow a computer to obtain information from images. They can be used, for example, for object classification, object identification and/or object detection, and they can implement techniques such as edge detection, corner detection, object detection, and the like. Examples of traditional computer vision algorithms disclosed in the specification include image processing algorithms such as binary morphological operations relating to the shape or morphology of features in an image, and the so-called Scale-Invariant Feature Transform (SIFT) and Binary Robust Invariant Scalable Keypoints (BRISK) algorithms which are feature point extraction and descriptor algorithms. Specifically, the SIFT and BRISK algorithms operate to identify points of interest in an image and describe regions near the points of interest using a descriptor. Traditional computer vision algorithms are algorithms that are pre-programmed to respond to data in a certain way, and they are typically implemented by executing programs on a CPU, GPU or DSP which have well-established instruction sets.
- 7 As described in paragraphs [0008] and [0009], deep neural networks (DNNs), and neural networks generally, have become more popular and more computationally complex to implement. Consequently, a significant amount of time and energy has been spent on developing DNN accelerators that allow DNNs to be implemented in an efficient manner, i.e. in a manner that requires less silicon area or less processing power when operating. DNN accelerators typically comprise hardware logic that is efficient at implementing traditional neural network layers such as convolution layers, activation layers, pooling layers and fully connected layers. Accordingly, a neural network accelerator may be extremely efficient at performing neural network calculations but, importantly, they may not be able to perform other sorts of calculations. For example, traditional computer vision algorithms cannot be implemented on a neural network accelerator in their native format.
- 8 Paragraph [0047] goes on to explain that the inventors have identified that because traditional computer vision algorithms involve making decisions based on an array of image values, operations such as matrix multiplications/manipulations and non-linear activation functions are useful, so DNN accelerators are very well suited to implementing these types of operations efficiently (both in terms of silicon area and processing time) in comparison to their implementation on a CPU, GPU and/or DSP. This means that traditional computer vision algorithms may be efficiently implemented using a DNN accelerator if they can be represented as a combination of NN primitives or layers.
- 9 Accordingly, the invention concerns methods and systems for processing images in accordance with a traditional computer vision algorithm using a neural network accelerator. The inventive method includes receiving a definition of the traditional computer vision algorithm that identifies a sequence of operations. Each of the operations is mapped to a set of neural network primitives that is mathematically equivalent to each operation. The neural network primitives are linked, according to the sequence, to form a neural network that represents the traditional computer vision algorithm. Thereafter input data to the traditional computer vision algorithm – in the form of images – is processed using a neural network accelerator in

accordance with the neural network that represents the traditional computer vision algorithm.

The amended claims

- 10 There are two independent claims, numbered 1 and 13, relating to a method and system respectively. At the hearing Ms Davy explained that claims 1 and 13 have the same key features so it is only necessary to consider claim 1. I agree. Claims 1 and 13 will stand or fall together, so it is convenient for me to focus on claim 1. Highlighting deletions using strikethrough and additions using underlining respectively, amended claim 1 sets out the invention in the following terms:

A method of ~~implementing~~ processing images in accordance with a traditional computer vision algorithm ~~as a neural network~~, the method comprising:
receiving a definition of the traditional computer vision algorithm that identifies a sequence of one or more traditional computer vision algorithm operations which form the traditional computer vision algorithm;
mapping each of the one or more traditional computer vision algorithm operations to a set of one or more neural network primitives that is mathematically equivalent to that traditional computer vision algorithm operation;
linking the one or more network primitives mapped to each traditional computer vision algorithm operation according to the sequence to form a neural network representing the traditional computer vision algorithm; and
processing, using a neural network accelerator, input data to the traditional computer vision algorithm in accordance with the neural network that represents the traditional computer vision algorithm, the input data to the traditional computer vision algorithm comprising images.

The Law

- 11 There is no dispute about the law in this case. The relevant provision of the act is section 1(2). It sets out that certain things are not inventions for the purposes of the act:

1(2) It is hereby declared that the following (among other things) are not inventions for the purposes of this Act, that is to say, anything which consists of -

- (a) ...;*
- (b) ...;*
- (c) ... a program for a computer;***
- (d) ...;*

but the foregoing provision shall prevent anything from being treated as an invention for the purposes of this Act only to the extent that a patent or application for a patent relates to that thing as such.

- 12 The approach to be taken for deciding matters under s.1(2) is the four-step approach set out by the Court of Appeal in *Aerotel*¹:

¹ *Aerotel Ltd v Telco Holdings Ltd* [2007] R.P.C. 7

- (1) *Properly construe the claim;*
- (2) *Identify the actual contribution;*
- (3) *Ask whether it falls solely within the excluded subject matter;*
- (4) *Check whether the actual or alleged contribution is actually technical in nature.*

- 13 The Court of Appeal explained the four-stage approach is a re-formulation of the “technical contribution” approach that was taken in its earlier judgments and noted that a contribution which consists solely of excluded matter does count as a technical contribution. In *Symbian*², the Court of Appeal re-affirmed that the question whether a technical contribution is revealed must be answered, and at paragraph 49 the court said in respect of computer programs that:

In deciding whether the Application reveals a “technical” contribution, it seems to us that the most reliable guidance is to be found in the Board’s analysis in Vicom and the two IBM Corp. decisions, and in what this court said in Merrill Lynch and Gale. Those cases involve a consistent analysis, which should therefore be followed unless there is a very strong reason not to do so.

- 14 In *AT&T*³ the High Court studied these cases and distilled the essence of what they reveal into five helpful ‘signposts’ to apply when considering whether a computer program makes a relevant technical contribution. In *HTC*⁴, the Court of Appeal reconsidered the fourth signpost and re-expressed it less restrictively. The signposts now read:

- i. whether the claimed technical effect has a technical effect on a process which is carried on outside the computer;*
- ii. whether the claimed technical effect operates at the level of the architecture of the computer; that is to say whether the effect is produced irrespective of the data being processed or the applications being run;*
- iii. whether the claimed technical effect results in the computer being made to operate in a new way;*
- iv. whether the program makes the computer a better computer in the sense of running more efficiently and effectively as a computer;*
- v. whether the perceived problem is overcome by the claimed invention as opposed to merely being circumvented.*

- 15 In *HTC*, the Court of Appeal also emphasised that although the signposts form part of the essential reasoning in many of the decisions relating to the most reliable guidance identified in *Symbian*, this does not mean they are prescriptive conditions, nor does it mean they will be determinative in every case.

Discussion

Step 1 – properly construe the claim

² *Symbian Ltd v Comptroller-General of Patents* [2009] R.P.C. 1

³ *AT&T Knowledge Ventures / Cvon Innovations v Comptroller General of Patents* [2009] EWHC 343 (Pat)

⁴ *HTC Europe Co Ltd v Apple Inc* [2013] EWCA Civ 451

- 16 I agree with Ms Davy that there is no dispute with the examiner concerning the construction of claim 1, nor is there any difficulty in construing claim 1. I need only add that, as Ms Davy said, the amendments to claim 1 mean that claim 1 is now explicitly limited to specify a method of processing images and that the input data processed comprises images.

Step 2 – identifying the actual contribution

- 17 Ms Davy reminded me of the factors to be considered when identifying the actual contribution outlined in paragraph 43 of *Aerotel*:

The second step – identify the contribution – is said to be more problematical. How do you assess the contribution? Mr Birss submits the test is workable – it is an exercise in judgment probably involving the problem said to be solved, how the invention works, what its advantages are. What has the inventor really added to human knowledge perhaps best sums up the exercise. The formulation involves looking at substance not form – which is surely what the legislator intended.

- 18 Both Ms Davy and Mr Cooney emphasised that a fundamental point of disagreement with the examiner is whether a known item of hardware – in this case the claimed neural network accelerator – can be taken into account when assessing the actual contribution made by an invention at step 2 of *Aerotel*. Ms Davy explained that in the pre-hearing report the examiner relies on the Manual of Patent Practice (section 1.21.1) and *Aerotel* (paragraphs 44 and 73) as establishing the principle that where claims recite standard hardware, such conventional apparatus does not form part of the contribution. Ms Davy said that the examiner has wrongly relied on this principle to disregard the role that the claimed neural network accelerator plays in the present invention namely to process images in accordance with a generated neural network that represents a traditional computer vision algorithm. Ms Davy emphasised that a fundamental principle of the law of excluded matter is that it is the claim as a whole that must be considered as set out in *Vicom*⁵:

Decisive is what technical contribution the invention as defined in the claim as a whole makes to the known art.

- 19 I believe Ms Davy and Mr Cooney are correct. The significance of paragraphs 44 and 73 of *Aerotel* is that when a computer-implemented invention relies on known hardware, the known hardware is not the contribution *per se*, even if an inventor wrongly alleges that they have invented the known hardware. Accordingly, the assessment of the *actual* contribution of such an invention must be made, as a matter of substance, by considering what it is the known hardware is programmed to do. While identifying an individual feature (in this case a neural network accelerator) as being disclosed in prior art is a relevant thing to do, it will always be necessary to consider it in the context of the invention as a whole before reaching a conclusion as to the *actual* contribution. Therefore, I accept Mr Cooney's submission that the examiner's approach does not seem to be consistent the approach taken in *Symbian* because the examiner's approach does not seem to allow for cases where a non-

⁵ T 208/84 (*Computer-related invention/VICOM*)

excluded program invention can be found, even when the hardware is plainly conventional, of which *Symbian* is a clear example.

- 20 In this case Ms Davy explained that the key advantage of the claimed invention is that it allows a traditional computer vision algorithm to be implemented more efficiently, in terms of silicon area and/or processing time, compared to the implementation of such algorithms on standard CPUs, GPUs or DSPs. This advantage is clearly set out in the description where, as Ms Davy explained, it is said that testing has shown that traditional computer vision algorithms can be implemented more efficiently on a DNN accelerator as a neural network than in the traditional format on a CPU, GPU or DSP. I also note the examiner accepts in their pre-hearing report that this is indeed the advantage of the invention.
- 21 Ms Davy and Mr Cooney accept (rightly, in my view) that neural network accelerators, and computers having neural network accelerators, are known. However, they emphasise strongly that in this case the advantage of the invention does not arise simply by putting a known piece of hardware (the neural network accelerator) into the claims. I accept Ms Davy's submission that the way the invention works in this case has two main steps: (i) generating a neural network that represents a traditional computer vision algorithm; and (ii) processing images, via that neural network, using a neural network accelerator. I am in no doubt that the advantage of this invention arises from the combination of these two main steps. The invention works by taking a traditional computer vision algorithm, putting it into a form that can be processed by special hardware, and processing image data with it in special hardware. If this were not the case then, as Ms Davy explained, the invention would not work since a conventional neural network accelerator cannot otherwise run a traditional computer vision algorithm.
- 22 I therefore accept that, as Ms Davy puts it in the skeleton argument, the problem solved by, and the contribution of, the method of claim 1 is a more efficient (in terms of silicon area and processing time) method of processing images in accordance with a traditional computer vision algorithm.

Steps 3 & 4 – asking if the contribution falls solely within excluded mater & checking if the contribution is technical in nature

- 23 At the hearing Ms Davy said that there is much case law to say that steps 3 and 4 can be dealt with together. I agree. Whether the contribution is technical in nature will have a direct impact on whether it falls solely with the program exclusion. It is convenient for me to deal with steps 3 and 4 together.
- 24 Ms Davy submitted that there are several *AT&T* signposts that indicate the contribution is technical. However, Ms Davy's principal argument is that the fifth signpost points to allowability in this case.

Signpost v

- 25 I agree with Ms Davy that the fifth signpost looks at the technical character of an alleged invention by means of the problem addressed. When the problem is a technical one, the alleged invention can be considered to have a technical nature leading to it fall outside of the exclusion if (but not only if) it solves the problem.

- 26 Ms Davy's argument on the fifth signpost was put simply. The problem addressed by the invention is how to process images in accordance with a traditional computer vision algorithm more efficiently, both in terms of silicon area and processing power. This is a *technical* problem. The subject matter of the claims *solves* this problem, it does not circumvent it.
- 27 Ms Davy submitted that it is well established that image processing is technical. Ms Davy said that this is clearly set out in the Board of Appeal's decision in *Vicom*. Here, it is helpful for me to note that in the *AT&T* judgment, Lewison J (as he then was) summarised the facts of *Vicom* as follows:

[17] *Vicom* (T 0208/84) concerned the digital processing of images. The application was rejected by the Examining Division on the ground that it claimed a mathematical method and a computer program as such. On appeal to the Board the appellant argued that a novel technical feature clearly existed in not only the hardware, but also in the method recited in the claims. The invention conferred a technical benefit namely a substantial increase in processing speed compared with the prior art. Digital filtering in general and digital image processing in particular are "real world" activities that start in the real world (with a picture) and end in the real world (with a picture). What goes on in between is not an abstract process, but the physical manipulation of electrical signals representing the picture in accordance with the procedures defined in the claims. Thus the claimed technical benefit was an increase in processing speed. The Board first dealt with whether the claimed invention was susceptible of industrial application. It was in that context that they made the observations quoted by Lord Neuberger in §37 of *Symbian*. They then went on to consider whether the claim was excluded as being a mathematical method as such; and concluded that it was not because the mathematical method which underlay the invention was being used in a technical process which was carried out on a physical entity by technical means. Turning to the computer program exclusion they said (§12):

“The Board is of the opinion that a claim directed to a technical process which process is carried out under the control of a program (be this implemented in hardware or in software), cannot be regarded as relating to a computer program as such within the meaning of Article 52(3) EPC, as it is the application of the program for determining the sequence of steps in the process for which in effect protection is sought. Consequently, such a claim is allowable under Article 52(2)(c) and (3) EPC.”

[18] The point which I think the Board are making is that what was claimed was not the computer program at all, but the process of manipulating the images. That process was a technical process and hence made a technical contribution. It is, I think, the same point that they make in the other extract quoted by Lord Neuberger (§ 15):

“Generally claims which can be considered as being directed to a computer set up to operate in accordance with a specified program (whether by means of hardware or software) for controlling or carrying out a technical process cannot be regarded as relating to a computer program as such and thus are not objectionable under Article 52(2)(c) and (3) EPC.”

- 28 What I take from this helpful summary is that, ultimately, Lewison J thought the point which the board in *Vicom* was making was that the claimed process of image manipulation was a *technical process* and hence made a *technical contribution*.
- 29 Ms Davy submitted that because the claims of the present application relate to processing images on a neural network accelerator using a neural network that represents a traditional computer vision algorithm, there is also a technical contribution in this case. Specifically, the claimed method can increase the speed of manipulating something tangible (images), which was held to be patentable in *Vicom*.
- 30 I accept Ms Davy's submissions. There is no doubt in my mind that the contribution made by the present invention is a technical solution to a technical problem. The two main steps of the invention – the generation of a neural network representing a traditional computer vision algorithm and the processing of images, via that neural network, using a neural network accelerator – combine to produce the claimed technical effect of processing image data more efficiently. I think this is an effect on a technical process as was the case in *Vicom*. I would add that I also accept Ms Davy's submission that the decisions in BL O/453/14 and BL O/173/08 further support this view.
- 31 In the pre-hearing report, the examiner does not apparently dispute that the problem might be regarded as a technical one. Nonetheless, the examiner does not consider that signpost v is passed. The examiner's reasoning is that it is only when running the neural network based algorithm that the computer is more efficient. According to the examiner this means that the computer is no better when running other programs, so the computer as a whole is not a better computer. Respectfully, I am unable to accept the examiner's reasoning. It does not seem to me that the examiner's argument addresses the applicant's arguments on fifth signpost appropriately. As I understand it, the applicant does not argue that they have invented a better general-purpose computer, nor do they argue that the claimed invention may process other applications or other forms of data more efficiently. In this case the contribution arises because, as Ms Davy explained, the inventors have realised that specific types of algorithms – traditional computer vision algorithms – can process image data more efficiently if they can be represented (in mathematically equivalent fashion) as a neural network that is implemented using a neural network accelerator.
- 32 Hence, I find that the present invention can reasonably be said to solve a technical problem in accordance with the fifth signpost. Claim 1 makes a contribution that is technical in nature, over and above its implementation as a program for a computer. Claim 1 is not excluded as a program for a computer "as such". The same finding applies to claim 13 and all the dependent claims. Also, Ms Davy submitted that claim 7, which introduces the optional step of training the neural network representing the traditional computer vision algorithm, has a still further technical benefit of improving the performance of the algorithm in some cases. However, I do not need to consider this final point.
- 33 Having reached this finding, I shall now deal with the remaining arguments before me briefly.

Signpost i

- 34 At the hearing I pointed out to Ms Davy that the applicant's arguments rely on the reasoning of the board of appeal *Vicom*. I asked Ms Davy why it is that there is no reference to signpost i in the skeleton arguments because it appears that signpost i was created to reflect the reasoning in *Vicom*. Ms Davy responded by saying that she had thought about signpost i but it seemed the invention is distinguished from *Vicom*. Ms Davy said that in *Vicom*, it seems that the invention in suit involved taking an image and producing an image from it whereas, while the present invention may do this, it may more generally identify information from images. In partial response to my question, Mr Cooney also made a more general point that the signposts may not perfectly fit to the idea of the present invention.
- 35 While Ms Davy and Mr Cooney may well be right, it seems to me that the claimed combination of putting a traditional computer vision algorithm into a form that can be processed by a neural network accelerator, and processing images with it using a neural network accelerator, produces a technical effect on a process that can reasonably be said to be "outside" the computer having the accelerator, i.e. processing images more efficiently. Although it is not necessary for me to say so, I believe that my acceptance of Ms Davy's arguments on *Vicom* in respect of signpost v indicates that the first signpost also points to a relevant technical contribution in this case.

Signpost ii

- 36 In the skeleton argument Ms Davy submits that the technical effect of the present application operates at the architectural level. Specifically, it is submitted that a neural network is an architectural component, like memory or cache, and the method of claim 1 allows control of the neural network accelerator to allow more efficient use of the resources of the computer/computer system. I am not inclined to agree because I think there are several factors that point away from an effect at the architectural level. Firstly, while I accept that a neural network accelerator is an architectural component *per se*, it does not necessarily follow from this that the technical effect in the present case is at the architectural level. Secondly, the applicant accepts that neural network accelerators, and computers having neural network accelerators, are known which suggests that the internal functionality of the accelerator itself is inherently unchanged. Thirdly, as I have already found, the technical effect in this case arises from the combination of the two main steps of claim 1 (the generation of a neural network that is mathematically equivalent to the traditional computer vision algorithm and its implementation on a hardware accelerator) – the effect does not arise from internal operation of the accelerator alone. Fourthly, the applicant accepts that the technical effect is limited to a particular type of data (image data) and a particular type of application (traditional image vision algorithms). The skeleton argument also refers me to the decision in BL O/317/10 but I find nothing in that decision that helps me reach a different conclusion on signpost ii. Signpost ii does not assist the applicant.

Signpost iv

- 37 Ms Davy also submits that executing the method of claim 1 on a computer (or computer system) that processes images in accordance with a traditional computer

vision algorithm, and that comprises a neural network accelerator, makes the computer (or computer system) a better computer (or computer system) in the sense of running more efficiently and effectively because: (i) processing images via a neural network accelerator in accordance with a neural network that represents the traditional computer vision algorithm allows the computer or computer system to process the images more efficiently; and (ii) by using the neural network accelerator as opposed to a CPU, GPU or DSP to process the images allows the CPU/GPU/DSP resources, which would otherwise be tied up processing mages, to be used for other processing.

- 38 I think the four factors I discussed above in respect of signpost ii must also point away from signpost iv being relevant in this case. For example, on Ms Davy' first point, while I accept that the combination of the generated neural network and the neural network accelerator leads to more efficient processing of image data in accordance with a traditional computer vision algorithm, I believe the increase in efficiency and effectiveness in this case is not at a high level of generality within the computer. Rather, it is highly dependent on both the type of data being processed (image data) and the particular type of application (the traditional computer vision algorithm). On Ms Davy's second point, I note again that the applicant accepts that neural network accelerators, and computers or computer systems with neural network accelerators, are known. All such known computer systems would, presumably, enjoy the advantage of freeing up CPU/GPU/DSP resources which would otherwise be tied up processing mages. Thus, it seems to me that this is not an effect or a contribution that falls outside the program exclusion in this case.

Gale

- 39 Finally, I record that I accept Ms Davy's and Mr Cooney's submissions that the present invention is distinguished from *Gale*⁶. In the pre-hearing report, the examiner refers to *Gale* (and the Manual of Patent Practice) as establishing the principle that an improvement in programming or an improved algorithm will not generally be enough to avoid exclusion unless there is something more to it in the form of a technical contribution. So far as the principle is concerned, I agree. However, my analysis shows that the present invention makes a technical contribution on top of being a computer program, so it avoids exclusion under section 1(2).

Decision

- 40 I have decided that amended claims 1-15 are not excluded under section 1(2)(c) of the act.
- 41 I remit the application back to the examiner so that it can continue its progress toward grant and for the search to be completed.

⁶ *Gale's Application* [1991] R.P.C. 305

Appeal

42 Any appeal must be lodged within 28 days after the date of this decision.

J PULLEN

Deputy Director, acting for the Comptroller