Intellectual Property Office

BL O/420/21

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PATENTS ACT 1977

APPLICANT	Imagination Technologies Limited
ISSUE	Whether applications GB1622135.0 and GB2100545.9 comply with Section 1(2) of The Act
HEARING OFFICER	Stephen Brown

DECISION

Introduction

1 Patent Application GB1622135.0 is a GB application with a priority date of 23rd Dec 2016. It was published as GB 2558271 on 11th July 2018. GB 2100545.9 is one of three divisional applications of GB 1622135.0 which was subsequently published as GB 2587591 on 31st March 2021.

2 Despite several rounds of correspondence, the applicant has been unable to convince the Examiner that either application is allowable under Section 1(2) of the Act. The applicant thus requested a hearing to resolve the matter.

3 This took place on 17th March 2021 by video link. The applicant was represented by Nick Wright of Slingsby Partners to whom I would like to thank for his comprehensive skeleton arguments. The hearing was also attended by Amy Tyler of Slingsby Partners and Dan Cooney and Anushya Jacob of Imagination Technologies. I was assisted by Mr Nigel Hanley and I am grateful to the applicants for allowing Examiner Rhys Miles to observe the proceedings.

The Applications

4 The applications share very similar specifications though each have claims of slightly different scope. They are both directed to a system that receives a stream of data values and determines the median values of this data. It works by operating on the values and storing these as intermediate values. The data received is contiguous and by storing intermediate median values it allows the system to use some of the values already calculated to calculate the next median. It is in effect a method of using a moving data window on the stream of data to calculate a median that takes account of where processing has already occurred on items within the window.

The Claims

5 The most recent claims for GB1622135.0 were filed on 26th August 2020 and for GB2100455.9 they were filed on 15th Jan 2021. It is these claims that form the basis of this decision. They are listed in Annexes A & B, respectively, at the end of this decision.

Issues considered

6 This decision will only consider the issues raised under Section 1(2) of the Act. As the examination has not been completed for the issues of inventive step and support, I will need to remit the application back to the Examiner should I find in the applicant's favour.

The Other Divisional Applications

7 The GB'135 application is the parent application to three divisionals of which, GB'545 is one. The other two are GB2100529.3 and GB2100547.5. These applications share subject matter of similar scope to the parent application and GB'545, respectively, with one major difference. In both instances the data stream has been specifically defined as consisting of "pixel values, audio samples of an audio signal or signal samples of a transmitted signal". In effect, their claims have been tethered to real world data and the Examiner has thereby found that these applications are prima facie allowable. Thus, I do not need to consider those applications here.

8 While I am not going to question that judgement here, it does helpfully frame the issue I need to resolve, namely are the claims allowable when the type of data stream is not specified?

The Law

9 The section of the Act concerning inventions excluded from patentability is Section 1(2). This reads:

> "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) A discovery, scientific theory or **mathematical method;**
>
> ...
>
> (c) a scheme, rule or method for performing a mental act, playing a game or doing business or **a program for a computer;**

…

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."

10 In order to decide whether an invention relates to subject matter excluded by Section 1(2), the Court of Appeal has said that the issue must be decided by answering the question of whether the invention reveals a technical contribution to the state of the art. The Court of Appeal in *Aerotel/Macrossan*[1] set out the following four-step approach to help decide the issue:

1) Properly construe the claim;

2) Identify the actual (or alleged) 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.

11 The operation of the approach is explained at paragraphs 40-48 of the judgment. Paragraph 43 confirms that identification of the contribution is essentially a matter of determining what it is the inventor has really added to human knowledge, and involves looking at substance, not form. Paragraph 47 adds that a contribution which consists solely of excluded matter will not count as a technical contribution.

Analysis

12 As is common in many applications where Section 1(2) is at issue, the construction of the claims here is very important. In the hearing Mr Wright took some time to explain his construction of the claims. In particular, he focussed heavily on two phrases in claim 1 of GB'135 though the same arguments apply equally to GB'545, namely:

a. a median determining unit embodied in hardware on an integrated circuit:

b(i). processing logic implemented in fixed function circuitry configured to … (GB 1622135.0)

b(ii) processing logic implemented in dedicated hardware configured to… (GB 2100545.9)

13 Mr Wright made it clear that he believes that these phrases go to the heart of the issues before me to such an extent that they will effectively determine the outcome of the decision. Put simply, Mr Wright's contention is that I can only construe the

[1] Aerotel Ltd v Telco Holdings Ltd (and others) and Macrossan's Application [2006] EWCA Civ 1371

claim as a piece of hardware. If that is the case, it is not a computer program nor is it a mathematical method.

14 To support his case, he referred me to several places in the specification of GB'135. To set out the problem that the applicant has sought to address he points out that Lines 1-5 on page 7 make it clear that the current state of the art shows that implementing a "median determining unit" in hardware is difficult. This is, he told me, is as a result of three issues, namely the size of the required chip, its power consumption and its processing latency. This he informs me is also known as "power, performance, area" or PPA. Page 17 lines 6 – 10 emphasise the view that dedicated hardware modules can allow for an optimisation of PPA and thus a better median determining unit.

15 He then directed my attention to Page 18, lines 4-14 and 18–22. This, he believes, show that whilst the claimed invention *can* be implemented in software, these references make it clear that the embodiment set out in the specification is hardware based.

16 Mr Wright also considered Page 37 line 27 to Page 38 line 5 relevant to this point. This makes clear that the amount of processing is reduced using the method they propose which means the size of the hardware is reduced.

17 The question for me to resolve is whether this supports a construction of the claim in such a way that it excludes any software element. It certainly points to the view that this is a hardware implementation. Consequently, it is clearly important for me to come to an understanding of what is meant by "fixed function circuitry". Indeed, this was a question I posed to Mr Wright at the hearing. In his view this term defines an arrangement of gates, transistors and registers that achieve a very specific function. Most importantly, there is no processor which needs to be told what to do with any stored instructions.

18 I am inclined to agree with this view. I thus construe the term "fixed function circuitry" to be a specific circuit that will enact the very specific "median calculating method" laid out in the claims. The situation is slightly different in GB'545 where the phrase "dedicated hardware" is used. However, viewing the claims in the light of the specification, I believe I must construe it as having exactly the same meaning with the same limitations.

19 In terms of the computer program objection, I do not believe I need to go any further. I have construed the claim to be for a specific piece of hardware which is not programmed or programmable in any way. Thus, it cannot be a program for a computer and thus cannot be excluded as such.

The Mathematical Method Exclusion

20 The situation with the mathematical method is a little more complex in both cases. There is no doubt that the specific hardware implements something that is mathematical in nature. Indeed, the claims define the system by the mathematical

steps it takes and not by any specific arrangement of gates, transistors or registers. I do not believe that Mr Wright disagreed with this point at the hearing.

21 At this point I will turn to the leading precedent on mathematical methods: *Gales Application*[2]. In *Gale*, a conventional ROM was programmed with an "improved square root calculation". The key argument in this case centred on whether the use of such known hardware was enough to negate the objection to a mathematical method (and a program). As Nicholls LJ said at Page 325 of this decision:

> *"But these physical differences are not material for patent purposes, because they constitute no more than the use of a compact disk for its intended purpose. Likewise, with a disc or ROM which records or reproduces a new set of instructions, if those instructions are recorded on a conventional disc, or are stored in a ROM using conventional methods. To decide otherwise would be to exalt form over substance".*
>
> Going on to quote from Genetech[3], he added:
>
> *"It would be nonsense for the Act to forbid the patenting of a computer program and yet permit the patenting of a floppy disk containing a computer program, or an ordinary computer when programmed with the program, it can well be said, as it seems to me, that a patent for a computer when programmed or for the disc containing the program is no more than a patent for a program as such".*

22 Thus, Nicholls LJ chose substance over form and refused *Gales application*. However, Mr Wright was keen to emphasise that there was a key difference between the current applications and that of *Gale*. Specifically, while the median determining unit is defined in terms of the mathematical steps it takes, its implementation in hardware is not conventional – it is dedicated "fixed function circuitry".

23 Once again, I agree with Mr Wright. I have construed the invention to be a piece of hardware constructed to specifically enact the defined mathematical steps. It is not a generic ROM containing a series of instructions. This, I believe, is enough to distinguish it from the situation in *Gale*.

24 I will now return, briefly, to the steps of the Aerotel test. I have construed the claims to relate to a unique fixed function circuit that will enact the specified median calculating method. I identify the contribution to have exactly the same scope. Such a contribution clearly does not fall within the mathematical method, or any other, exclusion of section 1(2) of the Act. Thus, it passes step 3 of the test.

25 Turning now to step 4, I must ask 'is the contribution technical in nature?'. Prima facie a fixed function circuit would certainly appear to be. There is, I believe, an even more compelling case with these applications since the mathematical method the circuitry is designed to enact is not just any old method of calculating median values. Mr Wright explained at the hearing that the method was chosen because when it is embodied in a fixed circuit that circuit will be smaller and use less power

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[2] *Gales Application [1991] RPC 305.*
[3] Genetech [1989] RPC 147.

than circuits using other methods. Page 7, line 32, to page 8, line 3, of the description of GB'135.0 confirms this point, stating that:

> *This allows embodiments described herein to reduce the complexity (e.g. the number of comparisons) to scale on the order of n (as compared to n^2 as described above for the bubble sort technique) and the time taken, or "latency", to scale on the order(1) (as compared to n as described above for the bubble sort technique). This can lead to huge reductions in the physical size (e.g. silicon area) of the hardware and in the power consumption of a median determining unit.*

26 This is clearly a technical contribution. I thus decide that the inventions in both applications are *not* excluded under section 1(2).

Other matters

27 Before remitting the applications back to the examiner, I note that claims 48 & 49 of GB'135.0 and claims 20 & 21 of GB'545.9 relate to computer programmes for implementing the claimed method. This clearly contradicts the other claims and casts doubt over the construction I have relied on above. I thus order that these claims will need to be deleted before either application can be granted. My decision that the inventions are not excluded only holds so long as the claims relate unambiguously to fixed function hardware.

28 I also note that for claims that relate to hardware, there is little mention of any actual circuitry. Furthermore, claims 50-53 of GB'135.0 and claims 23-25 of GB'545.9 make it clear that the claimed hardware only comes into being once an IC manufacturing system implements a circuit definition dataset that corresponds to claim 1 (at least).

29 At the hearing, Mr Wright and Mr Cooney clarified that such a dataset would be specified using a hardware description language such as Verilog or VHDL. They explained that given the mathematical steps laid out in the claims it would be straightforward for a technician to create the corresponding circuitry. This raises the question of whether the claims are "definition by result". While that was not an issue raised by the examiner, I will address it here for the sake of completeness.

30 The key precedent in this area is *No-Fume Ltd*[4]. This case makes it clear that while claims limited by the result to be achieved are undesirable they can nonetheless be allowed where it is the most precise way of defining the desired scope. I believe that this is the case here since, as Mr Wright explained, once given the mathematical steps outlined in the claims, any suitably skilled technician could easily make the corresponding circuitry. I am thus content that the claims are allowable is this respect too.

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[4] *No-Fume Ltd v Frank Pitchford Co Ltd 52 RPC 231*

G1/19

31 Just prior to the hearing the EPO Enlarged Board of Appeal issued their decision in G1/19. Mr Wright did, in supplemental skeleton arguments, mention this decision. However, I can deal with that relatively easily. It is an EPO decision and as has always been the case, I am bound by the precedents set in UK law. Given the freshly hatched nature of the decision and that no UK court has yet had the opportunity to express an opinion on it, I think it best in the circumstances for me to offer no opinion on its applicability, or otherwise, to applications under UK law.

Conclusion

32 I have decided that neither application is excluded as a computer program nor as a mathematical method, as such. I thus remit the application back to the Examiner for further processing, noting my instruction that claims 48 & 49 of GB'135.0 and claims 20 & 21 of GB'545.9 need to be deleted.

Appeal

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

Dr Stephen Brown

ANNEX A

GB 1622135.0

Independent & other important claims:

1. A data processing system configured to process a stream of data values, the data processing system comprising a median determining unit embodied in hardware on an integrated circuit, wherein the median determining unit is configured to receive data values of the stream and determine median values for use in the data processing system, the median determining unit comprising:

data storage logic configured to store intermediate data for use in determining median values; and

processing logic implemented in fixed function circuitry configured to:

determine intermediate data for use in determining a median value of a first subset of the received data values of the stream, and to cause the determined intermediate data to be stored in the data storage logic;

determine a median value of the received data values within the first subset using the determined intermediate data; and

for each of at least one further subset of the received data values of the stream:

• retrieve the intermediate data determined for a previous subset of data values from the data storage logic;

• use the retrieved intermediate data for the previous subset of data values to determine intermediate data for use in determining a median value of the current subset of received data values of the stream, wherein the current subset of data values at least partially overlaps with the previous subset of data values;

• cause the determined intermediate data for the current subset of data values to be stored in the data storage logic; and

• determine a median value of the received data values within the current subset using the determined intermediate data for the current subset;

wherein the median determining unit is further configured to output the determined median values for use in the data processing system, and

wherein the intermediate data for a subset of data values comprises, for each pairing of data values within the subset, an indication of which of the data values of the pairing is greater.

21 A data processing system configured to process a stream of data values, the data processing system comprising a median determining unit embodied in hardware on an integrated circuit, wherein the median determining unit is configured to receive data values of the stream and determine median values for use in the data processing system, wherein the median determining unit comprises:

processing logic implemented in fixed function circuitry configured to determine a median value of a first subset of the received data values of the stream; and

data storage logic configured to store first intermediate data used for determining the median value of the first subset of the received data values;

wherein the fixed-function circuitry of the processing logic is further configured to: (i) use the stored first intermediate data to determine second intermediate data, and (ii) use the second intermediate data to determine a median value of a second subset of the received data values of the stream, wherein the second subset of data values at least partially overlaps with the first subset of data values;

wherein the data storage logic is configured to store the second intermediate data for use in determining a median value of a further subset of the received data values, wherein the further subset of data values at least partially overlaps with the second subset of data values; and

wherein the median determining unit is further configured to output the determined median values for use in the data processing system, and wherein the intermediate data for a subset of data values comprises, for each pairing of data values within the subset, an indication of which of the data values of the pairing is greater.

23. A method of determining median values in a data processing system which processes a stream of data values, the method comprising:

receiving data values of the stream at a median determining unit of the data

processing system, wherein the median determining unit is embodied in hardware

on an integrated circuit; and

performing the following functions with dedicated hardware of the median determining unit:

determining and storing intermediate data for use in determining a median value of a first subset of the received data values of the stream;

determining a median value of the received data values within the first subset using the determined intermediate data: and

for each of at least one further subset of the received data values of the stream:

using the stored intermediate data determined for a previous subset of data values to determine intermediate data for use in determining a median value of the current subset of the received data values of the stream, wherein the current subset of data values at least partially overlaps with the previous subset of data values;

storing the determined intermediate data for the current subsetof data values; and

determining a median value of the received data values with the current subset using the determined intermediate data for the current subset;

the method further comprising outputting the determined median values for use in the data processing system;

wherein intermediate data for a subset of data values comprises, for each pairing of data values within the subset, an indication of which of the data values of the pairing is greater

44 A method of determining median values in a data processing system which processes a stream of data values, the method comprising:

receiving data values of the stream at a median determining unit of the data processing system, wherein the median determining unit is embodied in hardware on an integrated circuit; and

performing the following functions with fixed function circuitry of the median determining unit:

determining a median value of a first subset of the received data values of the stream;

storing first intermediate data used for determining the median value of the first subset of the received data values;

using the stored intermediate data to determine second intermediate data,

using the second intermediate data to determine a median value of a second subset of the received data values of the stream, wherein the second subset of data values at least partially overlaps with the first subset of data values; and

storing the second intermediate data for use in determining a median value of a further subset of the received data values, wherein the further subset of data values at least partially overlaps with the second subset of data values; and

outputting the determined median values for use in the data processing system,

wherein the intermediate data for a subset of data values comprises, for each pairing of data values within the subset, an indication of which of the data values of the pairing is greater

50 An integrated circuit definition dataset that, when processed in an integrated circuit manufacturing system, configures the integrated circuit manufacturing system to manufacture a data processing system as claimed in any of claims 1 to 22 or 46.

51. A non-transitory computer readable storage medium having stored thereon a computer readable description of an integrated circuit that, when processed in an integrated circuit manufacturing system, causes the integrated circuit manufacturing system to manufacture a data processing system as claimed in any of claims 1 to 22 or 46.

52. An integrated circuit manufacturing system configured to manufacture a data processing system as claimed in any of claims 1 to 22 or 46.

53. An integrated circuit manufacturing system comprising:

a non-transitory computer readable storage medium having stored thereon a computer readable description of an integrated circuit that describes a data

processing system as claimed in any of claims 1 to 22 or 46;

a layout processing system configured to process the integrated circuit description so as to generate a circuit layout description of an integrated circuit embodying the data processing system as claimed in any of claims 1 to 22 or 46;

and

an integrated circuit generation system configured to manufacture the data processing system according to the circuit layout description.

ANNEX B

GB 2100545.9

Independent & other important claims:

1. A data processing system configured to process a stream of data values, the data processing system comprising a median determining unit embodied in hardware on an integrated circuit, wherein the median determining unit is configured to receive data values of the stream and determine median values for use in the data processing system, the median determining unit comprising:

   data storage logic configured to store intermediate data for use in determining median values; and

   processing logic implemented in fixed function circuitry configured to:

   determine intermediate data for use in determining a median value of a first subset of the received data values of the stream, and to cause the determined intermediate data to be stored in the data storage logic;

   determine a median value of the received data values within the first subset using the determined intermediate data; and

   for each of at least one further subset of the received data values of the stream:

   - retrieve the intermediate data determined for a previous subset of data values from the data storage logic;
   - use the retrieved intermediate data for the previous subset of data values to determine intermediate data for use in determining a median value of the current subset of received data values of the stream, wherein the current subset of data values at least partially overlaps with the previous subset of data values;
   - cause the determined intermediate data for the current subset of data values to be stored in the data storage logic; and
   - determine a median value of the received data values within the current subset using the determined intermediate data for the current subset;

   wherein the median determining unit is further configured to output the determined median values for use in the data processing system, and wherein the intermediate data for a subset of data values comprises, for each of the data values in the subset of data values, an index value indicating a sorted position of the data value within the subset of data values, wherein the median determining unit is configured to determine a median value of the data values within a subset of data values by selecting one of the data values in the subset of data values based on the index values .

14. A data processing system configured to process a stream of data values, the data processing system comprising a median determining unit embodied in hardware on an integrated circuit, wherein the median determining unit is configured to receive data values of the stream and determine median values for use in the data processing system, wherein the median determining unit comprises:

processing logic implemented in fixed function circuitry configured to determine a median value of a first subset of the received data values of the stream; and

data storage logic configured to store first intermediate data used for determining the median value of the first subset of the received data values;

wherein the fixed-function circuitry of the processing logic is further configured to:

(i) use the stored first intermediate data to determine second intermediate data, and

(ii) use the second intermediate data to determine a median value of a second subset of the received data values of the stream, wherein the second subset of data values at least partially overlaps with the first subset of data values;

wherein the data storage logic is configured to store the second intermediate data for use in determining a median value of a further subset of the received data values, wherein the further subset of data values at least partially overlaps with the second subset of data values; and

wherein the median determining unit is further configured to output the determined median values for use in the data processing system, and wherein the intermediate data for a subset of data values comprises, for each of the data values in the subset of data values, an index value indicating a sorted position of the data value within the subset of data values, wherein the median determining unit is configured to determine a median value of the data values within a subset of data values by selecting one of the data values in the subset of data values based on the index values.

16. A method of determining median values in a data processing system which processes a stream of data values, the method comprising:

receiving data values of the stream at a median determining unit of the data processing system, wherein the median determining unit is embodied in hardware on an integrated circuit; and

performing the following functions with fixed function circuitry of the median determining unit:

determining and storing intermediate data for use in determining a median value of a first subset of the received data values of the stream;

determining a median value of the received data values within the first subset using the determined intermediate data; and for each of at least one further subset of the received data values of the stream:

- using the stored intermediate data determined for a previous subset of data values to determine intermediate data for use in determining a median value of the current subset of received data values of the stream, wherein the current subset of data values at least partially overlaps with the previous subset of data values;
- storing the determined intermediate data for the current subset of data values; and
- determining a median value of the received data values within the current subset using the determined intermediate data for the current subset;

the method further comprising outputting the determined median values for use in the data processing system, wherein the intermediate data for a subset of data values comprises, for each of the data values in the subset of data values, an index value indicating a sorted position of the data value within the subset of data values, wherein the median determining unit is configured to determine a median value of the data values within a subset of data values by selecting one of the data values in the subset of data values based on the index values.

19. A method of determining median values in a data processing system which processes a stream of data values, the method comprising:

receiving data values of the stream at a median determining unit of the data processing system, wherein the median determining unit is embodied in hardware on an integrated circuit; and

performing the following functions with fixed function circuitry of the median determining unit:
determining a median value of a first subset of the received data values of the stream;

storing first intermediate data used for determining the median value of the first subset of the received data values;

using the stored intermediate data to determine second intermediate data;

using the second intermediate data to determine a median value of a second subset of the received data values of the stream, wherein the second subset of data values at least partially overlaps with the first subset of data values; and

storing the second intermediate data for use in determining a median value of a further subset of the received data values, wherein the further subset of data values at least partially overlaps with the second subset of data values; and

outputting the determined median values for use in the data processing system, wherein the intermediate data for a subset of data values comprises, for each of the data values in the subset of data values, an index value indicating a sorted position of the data value within the subset of data values, wherein the median determining unit is configured to determine a median value of the data values within a subset of data values by selecting one of the data values in the subset of data values based on the index values.

23. An integrated circuit definition dataset that, when processed in an integrated circuit manufacturing system, configures the integrated circuit manufacturing system to manufacture a data processing system as claimed in any of claims 1 to 15.

24. A non-transitory computer readable storage medium having stored there on a computer readable description of an integrated circuit that, when processed in an integrated circuit manufacturing system, causes the integrated circuit manufacturing system to manufacture a data processing system as claimed in any of claims 1 to 15.

25. An integrated circuit manufacturing system comprising:

a non-transitory computer readable storage medium having stored thereon a computer readable description of an integrated circuit that describes a data processing system as claimed in any of claims 1 to 15;

a layout processing system configured to process the integrated circuit description so as to generate a circuit layout description of an integrated circuit embodying the data processing system as claimed in any of claims 1 to 15; and

an integrated circuit generation system configured to manufacture the data processing system according to the circuit layout description.