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Commissioner's Decision #1593

Décision du Commissaire n° 1593

Date: 2021-09-08

TOPIC: J-00 Meaning of Art

J-10 Computer Programs

J-50 Mere Plan

SUJET: J-00 Signification de la technique

J-10 Programmes d'ordinateur

J-50 Simple Plan

Application No. : 2,803,644

Demande n° 2 803 644

IN THE CANADIAN PATENT OFFICE

DECISION OF THE COMMISSIONER OF PATENTS

Patent application number 2,803,644, having been rejected under subsection 30(3) of the *Patent Rules* (SOR/96-423) as they read immediately before October 30, 2019, has consequently been reviewed in accordance with paragraph 199(3)(c) of the *Patent Rules* (SOR/2019-251). The recommendation of the Patent Appeal Board and the decision of the Commissioner are to refuse the application.

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INTRODUCTION

- [1] This recommendation concerns the review of rejected Canadian patent application number 2,803,644 which is entitled “Equation-based Assessment Grading Method and Participant Response System Employing Same” and is owned by Smart Technologies ULC (“the Applicant”).
- [2] A review of the rejected application has been conducted by the Patent Appeal Board (“the Board”) pursuant to paragraph 199(3)(c) of the *Patent Rules* (SOR/2019-251). As explained in more detail below, my recommendation to the Commissioner of Patents is to refuse the application.

BACKGROUND

The application

- [3] Canadian patent application 2,803,644, based on a previously filed *Patent Cooperation Treaty* application, with a claimed priority date of June 25, 2010, was laid open to public inspection on December 29, 2011.
- [4] The application relates to assessment grading methods in participant response systems. More specifically, it relates to an equation-based assessment grading method that compares syntax trees generated from responses and solutions.

Prosecution history

- [5] On January 15, 2018, a Final Action (“FA”) was issued pursuant to subsection 30(4) of the *Patent Rules* (SOR/96-423) as they read immediately before October 30, 2019, in which the application was rejected on the basis of non-statutory subject-matter. The FA stated that claims 1 to 34 on file (“claims on file”), dated May 10, 2016, did not comply with section 2 of the *Patent Act*.
- [6] On July 12, 2018, a response to the FA (“R-FA”) was filed by the Applicant. In the R-FA, the Applicant argued that the claimed invention was directed to patentable subject-matter and complied with section 2 of the *Patent Act*. No proposed amendments were submitted.
- [7] Since the Examiner maintained the position that the application did not comply with section 2 of the *Patent Act*, the application was forwarded to the Board on November 30,

2018, along with a Summary of Reasons (“SOR”) explaining why the claims on file did not define patentable subject-matter.

- [8] The SOR was forwarded to the Applicant on December 4, 2018.
- [9] The undersigned has been assigned to review the rejected application on behalf of the Commissioner of Patents under paragraph 199(3)(c) of the *Patent Rules* (SOR/2019-251).
- [10] In a preliminary review letter dated June 23, 2021 (“PR letter”), I presented my preliminary analysis and rationale as to why the claims on file did not comply with section 2 of the *Patent Act*. The PR letter also offered the Applicant the opportunities to make written submissions and to attend an oral hearing.
- [11] In a response to the PR letter (“R-PR”) dated July 26, 2021, the Applicant argued that the claims on file were directed to patentable subject-matter and complied with section 2 of the *Patent Act*. A set of proposed claims 1 to 102 (“proposed claims”) were also submitted for consideration.
- [12] An oral hearing was held on August 6, 2021, via teleconference.

ISSUE

- [13] There is only one issue to be considered in this review: whether the claims on file define patentable subject-matter, as required by the *Patent Act*. The proposed claims are also considered.

LEGAL PRINCIPLES AND PATENT OFFICE PRACTICE

Purposive construction

- [14] In accordance with *Free World Trust v Électro Santé Inc*, 2000 SCC 66 and *Whirlpool Corp v Camco Inc*, 2000 SCC 67, purposive construction is performed from the point of view of the person skilled in the art in light of the relevant common general knowledge (CGK), considering the whole of the disclosure including the specification and drawings. In addition to interpreting the meaning of the terms of a claim, purposive construction distinguishes the essential elements of the claim from the non-essential elements. Whether or not an element is essential depends both on the intent expressed in or inferred from the claim, and on whether it would have been obvious to the skilled person that a variant has a

material effect upon the way the invention works.

- [15] “Patentable Subject-Matter under the *Patent Act*” (CIPO, November 2020) [PN2020–04] also discusses the application of these principles, pointing out that all elements set out in a claim are presumed essential unless it is established otherwise or such presumption is contrary to the claim language.

Patentable subject-matter

- [16] The definition of invention is set out in section 2 of the *Patent Act*:

invention means any new and useful art, process, machine, manufacture or composition of matter, or any new and useful improvement in any art, process, machine, manufacture or composition of matter.

- [17] Subsection 27(8) of the *Patent Act* also prescribes that:

No patent shall be granted for any mere scientific principle or abstract theorem.

- [18] PN2020–04 describes the Patent Office’s approach to determining if a claim is patentable subject-matter:

To be both patentable subject-matter and not be prohibited under subsection 27(8) of the *Patent Act*, the subject-matter defined by a claim must be limited to or narrower than an actual invention that either has physical existence or manifests a discernible physical effect or change and that relates to the manual or productive arts, meaning those arts involving or concerned with applied and industrial sciences as distinguished in particular from the fine arts or works of art that are inventive only in an artistic or aesthetic sense.

- [19] PN2020–04 further describes the Patent Office’s approach to determining if a computer-related invention is patentable subject-matter. For example, the mere fact that a computer is among the essential elements of the claimed invention does not necessarily mean that the claimed invention is patentable subject-matter. An algorithm itself is abstract and unpatentable subject-matter. A computer programmed to merely processes the algorithm in a well-known manner without solving any problem in the functioning of the computer will not make it patentable subject-matter because the computer and the algorithm do not form part of a single actual invention that solves a problem related to the manual or productive arts. On the other hand, if processing the algorithm improves the functionality of the computer, then the computer and the algorithm would together form a single actual invention that solves a problem related to the manual or productive arts and the subject-matter defined by the claim would be patentable.

[20] In *Schlumberger Canada Ltd v Commissioner of Patents*, [1982] 1 FC 845 (CA) [*Schlumberger*], the court concluded that, although a computer was necessary for the invention to be put into practice, the computer did not form part of “what has been discovered” and thus was not relevant in determining whether the claimed invention was patentable subject-matter; the computer was merely being used to make the kind of calculations it was invented to make.

[21] In the R-PR (page 2), the Applicant argued that subsection 27(8) of the *Patent Act* should not be considered for this review since the FA did not raise an objection under this subsection.

[22] However, subsection 86(9) of the *Patent Rules* provides for the identification of new defects during the review process:

Additional defects

(9) If, during the review of a rejected application for a patent, the Commissioner has reasonable grounds to believe that the application does not comply with the Act or these Rules in respect of defects other than those indicated in the final action notice, the Commissioner must by notice inform the applicant of those defects and invite the applicant to submit arguments, not later than one month after the date of the notice, as to why the application does comply.

[23] In the PR letter (page 3), the Applicant was given the applicability of subsection 27(8) of the *Patent Act* in relation to the general assessment of patentable subject-matter in accordance with *PN2020-04*. Further, at pages 9 and 10 of the PR letter, the Applicant was given notice of the applicability of subsection 27(8) of the *Patent Act* within the patentable subject-matter analysis and in relation to the preliminary view of the Panel as to the patentability of the claims.

[24] In light of the above, compliance with subsection 27(8) of the *Patent Act* is considered as part of this recommendation.

ANALYSIS

Purposive construction

[25] There are 34 claims on file, including independent claims 1, 20, 28, 30, and 34, and dependent claims 2 to 19, 21 to 27, 29, and 31 to 33. For this analysis, I consider claim 1 to be representative of the independent claims and also of claim 29:

1. A computerized assessment grading method comprising:
 receiving, by a processing device, an encoded equation-based response to at least one assessment question, said at least one assessment question comprising an equation;
 decoding, by the processing device, said encoded equation-based response to yield a decoded equation-based response;
 determining, by the processing device, a grading method selected from a plurality of different grading methods;
 creating, by the processing device, (i) a syntax tree for the decoded equation-based response and (ii) a syntax tree for at least one solution to the at least one assessment question;
 determining, by the processing device, whether the decoded equation-based response matches the equation of said at least one assessment question;
 if the decoded equation-based response does not match the equation of said at least one assessment question, comparing, by the processing device, the syntax trees; and
 grading, by the processing device, the response according to the determined grading method based on the results of the comparison, wherein said grading comprises awarding a score based on the extent to which nodes of the syntax trees match.

[26] Claims 2 to 19, 21 to 27, and 31 to 33 set forth the following additional features:

- the grading method is selected from Order Equivalence, Formal Equivalence, and Content Equivalence grading methods (claims 2, 21, and 31);
- decoding the encoded equation-based response into a typesetting language, such as LaTeX (claims 3, 4, 22, 23, 32, and 33);
- parsing the decoded equation-based response and the at least one solution into tree-shaped hierarchies of operators and operands thereby to form the syntax trees, and the tree-shaped hierarchies of operators and operands are generally based on orders of operation (claim 5, 8, 13, 16, and 24);
- normalizing the syntax trees into canonical form where common operators are simplified to a single n-ary operator (claims 6, 7, 14 and 15);
- operations to be performed first are placed at the bottom of the syntax trees and operations to be performed last are placed at the top of the syntax trees (claims 9, and 17);
- determining if the hierarchies of operators and operands match (claims 10, 11, and 25);
- when the syntax trees comprise the same nodes, said grading comprises grading the response as correct (claim 12);
- prior to said comparing, determining if the syntax tree created for the decoded equation-based response is valid, and when said syntax tree created for the decoded equation-based

response is not valid, bypassing said comparing and grading said response as incorrect (claims 18 and 26); and

- receiving the encoded equation-based response from one or more response devices (claims 19 and 27).

The person skilled in the art and their common general knowledge (CGK)

[27] The FA (page 2) identified the skilled person and their CGK as:

The skilled person or persons may consist of a team of teachers and information technology engineers familiar with the design of participant response systems employing methods for grading equation-based responses. The skilled person also has knowledge of known equation-based assessment grading methods.

...

As described in the background of the invention, it is well known in the art to have participant response systems for enabling participants of an event to enter responses to posed questions (pars. 2-8). ActivExpression™ and CPS Pulse™ systems allow questions to be administered, the solutions to which are equations which are graded by an engine that assesses the solutions to these questions (par. 9).

In addition, encoding, transmitting, receiving and decoding information are considered to be part of the common general knowledge in the art. This is reinforced by the fact that although the claims describe receiving an encoded equation-based response to at least one assessment question, said at least one assessment question comprising an equation and decoding said encoded equation-based response to yield a decoded equation-based response, no details are given on encoding and decoding of the equation-based response. Implicitly it is assumed that these features represent common knowledge in the art and are not related to the problem faced by the inventor. This is also reinforced by par. 74 of the description, which indicates that “different communication and encoding protocols for communicating the responses to the xThink Engine than those described above may alternatively be used.”

[28] In the R-FA (pages 2 to 3), the Applicant disagreed with the above identification but did not provide a definition of the skilled person.

[29] Based on the “Background of the Invention” section of the present application, I preliminarily identified the skilled person in the PR letter as:

A team of persons skilled in the field of participant response systems used for grading equation-based responses and technologists experienced with developing and providing the software, tools and infrastructure conventionally used to support the activities and designs of such systems.

[30] In the R-PR (page 2 to 3), the Applicant disagreed with this identification and argued that “equation-based responses” should not be part of the CGK, and stated that:

Applicant submits that the skilled person should be identified as:

- A team of persons skilled in the field of participant response systems used for grading responses and technologists experienced with developing and providing the software, tools and infrastructure conventionally used to support the activities and designs of such systems.

[31] For this review, this identification, which changes “equation-based responses” of the identification in the PR letter to “responses,” is adopted.

[32] The PR letter also identified CGK of the skilled person:

During the preliminary review, I have also relied upon the following documents to more clearly establish the CGK:

D1: Zanibbi et al., “Recognizing Mathematical Expressions Using Tree Transformation,” IEEE Transactions on Patent Analysis and Machine Intelligence, Vol. 24, No. 11, November 2002.

D2: Smart Technologies - Products, available at:
<https://web.archive.org/web/20091225211722/http://www2.smarttech.com:80/st/en-us/products>, December 25, 2009.

D3: Smart Technologies -Response CE, available at
<http://web.archive.org/web/20091118175254/http://www2.smarttech.com/st/en-US/Products/SMART+Response/SMART+Response+CE/>, November 18, 2009.

D4: Mathematical Markup Language (MathML) Version 2.0 (Second Edition), World Wide Web Consortium (W3C), available at
<https://www.w3.org/TR/MathML2/>, October 21, 2003.

In my preliminary view, as shown in D1, which is a well-cited and well-known document, the skilled person is familiar with techniques of recognition of mathematical notations, including utilizing syntax tree transformations to represent mathematical expressions. It is also my preliminary view that well-known typesetting languages such as LaTeX are often used to represent the parsing of mathematical expressions, as shown in D1 and numerous academic and industry documents.

Further, before the claim date of the present application, virtual classroom software that could be used to perform student assessments, such as SMART Notebook™ and SMART Response™, were widely known, as shown in D2 and D3.

Regarding the encoding and decoding of mathematics for computer processing or electronic communication, it has been a well-recognized problem since the

1980s and there were many techniques and protocols implemented for this purpose (D4, section 1.2.1). For example, MathML, a popular industry standard used extensively by educational institutions, was designed to “encode mathematical material suitable for teaching and scientific communication at all levels” and “facilitate conversion to and from other mathematical formats, both presentational and semantic... such as TeX” (D4: section 1.2.1).

Therefore, based on certain points of CGK extracted from D1 to D4 and the “Background of the Invention” section of the present application, I preliminarily consider the following knowledge as CGK:

- Knowledge regarding design, implementation, operation, and maintenance of a computerized participant response systems for grading equation-based responses using conventional computer technologies;
- Knowledge of well-known techniques on recognition and representation of mathematical notations, including using LaTeX notations and syntax tree transformations to represent mathematical expressions; and
- Knowledge of well-known protocols used to encode and decode mathematical notations for computer processing and communications.

[33] In the R-PR (Pages 3 to 4), the Applicant disagreed with this identification and submitted their identification of the CGK:

Applicant submits that the CGK would be:

- Knowledge regarding design, implementation, operation, and maintenance of a computerized participant response systems for grading responses using conventional computer technologies;
- Knowledge of well-known techniques on recognition and representation of mathematical notations, including using LaTeX notations and syntax tree transformations to represent mathematical expressions; and
- Knowledge of well-known protocols used to encode and decode mathematical notations for computer processing and communications.

[34] For this review, this identification, which changes “equation-based responses” of the identification in the PR letter to “responses,” is adopted.

Essential elements

[35] As indicated in the PR letter, according to *PN2020-04*, purposive construction is conducted by considering where the skilled person would have understood the Applicant to have intended to place the fences around the monopoly being claimed.

[36] Considering the whole of the specification, the skilled person would understand that there is no use of language in the claims indicating that any of the elements are optional, a preferred embodiment, one of a list of alternatives, or non-essential. Therefore, all elements

recited in each of the claims are presumed to be essential.

Patentable subject-matter

- [37] Although all the claimed elements, including the computer elements, are presumed to be essential, as noted in *PN2020-04*, the mere fact that a computer is identified to be an essential element of a claimed invention for the purpose of determining the fences of the monopoly under purposive construction does not necessarily mean that the subject-matter defined by the claim is patentable subject-matter and outside of the prohibition under subsection 27(8) of the *Patent Act*.
- [38] Further, as stated in *PN2020-04*, “[t]o be both patentable subject-matter and not be prohibited under subsection 27(8) of the *Patent Act*, the subject-matter defined by a claim must be limited to or narrower than an actual invention that either has physical existence or manifests a discernible physical effect or change and that relates to the manual or productive arts,” referencing, in part, *Canada (Attorney General) v Amazon.com, Inc*, 2011 FCA 328 [*Amazon*] paras 42 and 66 to 69. In *Amazon* (paras 61 to 63, 66, and 69) the court stated that a disembodied idea cannot be rendered patentable merely because it has a practical embodiment or a practical application. *Amazon* also noted that this was the situation in *Schlumberger*, where the computer was merely being used to make the kind of calculations it was invented to make.
- [39] As explained in the PR letter, for the present application, the claimed computer elements, such as “processing device,” “input interface,” and “memory storing computer program code,” are directed to generic computer components that are used in a well-known manner to input and process data. Therefore, the mere presence of these elements would not render an abstract algorithm patentable, according to *PN2020-04*. The skilled person, when reading the specification as a whole, would understand how these elements might be implemented and used conventionally by the claimed method, without any improvement on the computer function. Therefore, the computer elements as claimed are merely being used to make the kind of generic calculations and data processing they are known to make (see *Schlumberger*) and do not form part of the actual invention.
- [40] Additionally, regarding the feature of encoding and decoding equation-based responses, the present application neither discloses nor claims any new or improved encoding or decoding techniques beyond known protocols. Indeed, in paragraph [00074], the description recites that “different communication and encoding protocols for communicating the responses” may “alternatively be used” without providing further details. Therefore, the skilled person,

when reading the specification as a whole, would understand that the actual invention is not directed to how the responses are encoded, decoded, or transmitted, but to the abstract grading algorithm utilizing syntax tree comparisons. As the disclosure is focused on the abstract algorithm and its benefits, the encoding and decoding feature is not considered part of the actual invention, and would not impart physicality to the claimed method.

- [41] In the R-PR (page 5) and during the hearing, the Applicant argued that the present application solves problems of “(1) accurately assessing equation-based responses having multiple correct answers using a participant response system; (2) providing partial marks when assessing equation-based responses using a participant response system; and (3) efficiently assessing equation-based responses using a participant response system.” The Applicant further stated that these problems “are directed to problems associated with the functioning of the computer” and “providing partial marks was something that was previously unknown in the art for equation-based responses.”
- [42] For the first two problems, the Applicant stated in the R-PR (page 5): “[t]he first two problems are somewhat related in they address accuracy of grading equation-based responses.” It is my view that these problems relate to the accuracy and flexibility of the grading algorithm. The specification does not provide any details regarding how these features may be implemented using specific computer components beyond general-purpose computer elements. The skilled person would understand that these are directed to improvements on the algorithm itself, not on the computer functionalities.
- [43] For the third problem, in the R-PR (pages 6 to 8), the Applicant argued that:

In particular, claim 1 recites, *inter alia*,

determining, by the processing device, whether the decoded equation-based response matches the equation of said at least one assessment question;
if the decoded equation-based response does not match the equation of said at least one assessment question, comparing, by the processing device, the syntax trees; and

Similarly, claim 20 recites, *inter alia*,

determining, by the processing device, if the response comprises an equation that matches the equation of the assessment question;
if the response does not comprise an equation that matches the equation of the assessment question, comparing, by the processing device, (i) the response hierarchy of operators and operands with (ii) a solution hierarchy of operators and operands; and

The order of these two steps is important to efficiently processing the equation-based responses by first performing a matching operation of the equation-based

response to the equation of the assessment question. If the equation-based response does not match the equation of the assessment question, then more computationally expensive operations are performed by comparing the syntax trees (or hierarchies) and providing a grade based on the comparison.

- [44] Similar arguments were raised for claims 18, 26, and 28.
- [45] There is no evidence provided in the specification that the claimed invention is computationally more efficient compared with prior art, such as the “string comparison” method mentioned in the application. In the case where a response comprises an equation matching a predetermined solution, the proposed method would perform similarly to the known method and mark the response correct, which completes the assessment without further data processing. In the case where a response does not comprise an equation matching a predetermined solution, the known method would mark the response incorrectly without further actions, while the claimed method would use computationally expensive syntax tree comparison to perform further analysis. Therefore, although the claimed method might provide more flexible and accurate marking results, it does not appear to have better computational efficiency compared with known methods.
- [46] In the R-PR (page 6), the Applicant also argued that “[c]laims 1 and 20 differ in one significant way. For claim 1, the processing device directly receives the encoded equation-based responses whereas for claim 20, the processing device may indirectly receive the encoded equation-based responses.”
- [47] The present application is not directed to new means of receiving responses, including new response devices. Indeed, the disclosure stated that devices and software that were well-known before the claim date, such as host computer running SMART NotebookTM whiteboarding software, and SMART ResponseTM CE Teacher software, may be used for the claimed algorithm. Moreover, claim 1 only recites “receiving, by a processing device, an encoded equation-based response” and claim 20 recites “upon receipt of an encoded equation-based response to an assessment question, decoding, by a processing device...” In this case, claims 1 and 20 on file do not specify any details regarding how the responses are received, directly or indirectly. Therefore, the skilled person, when reading the specification as a whole, would understand that the input means and the response device are not part of the actual invention, and would not impart physicality to the claimed method.
- [48] Consequently, I consider that the actual invention of claims 1, 20, 28 to 30, and 34 on file is directed to an abstract algorithm of grading equation-based responses using syntax tree

comparisons. This subject-matter is directed to an abstract algorithm, is prohibited under subsection 27(8) of the *Patent Act*, and is not considered to be patentable subject-matter under section 2 of the *Patent Act*.

[49] Claims 2 to 19, 21 to 27, and 31 to 33 recite further data processing rules concerning how the grading algorithm is performed. These claims are directed to abstract rules and do not comply with subsection 27(8) and section 2 of the *Patent Act* for the same reasons above.

[50] Therefore, claims 1 to 34 on file do not define patentable subject-matter and do not comply with subsection 27(8) and section 2 of the *Patent Act*.

Proposed claims

[51] In the R-PR (page 7), the Applicant explained additional features introduced by the proposed claims:

Generally, claims 1-34 recite additional features in the independent claims for presenting assessment questions and entering a solution in a response device. Generally, claims 35-68 recite in further detail the improvement of efficiency in grading equation-based responses in a participant response system as well as including the partial mark features in the independent claims. Generally, claims 69-102 emphasize in the independent claims that the assessment questions are presented during a lesson and that the scores are added to a grade associated with a participant during the lesson. Claims 69-102 also incorporate the partial mark features.

[52] Since there is no use of language indicating that any one of these features is optional, a preferred embodiment, one of a list of alternatives, or non-essential, all features presented in the proposed claims are considered to be essential to the proposed claims.

[53] With regard to the features of presenting assessment questions and entering solutions to a response device, these are directed to how the questions and solutions are obtained, not to how the grading method is performed. Moreover, the application does not teach or disclose new input device for receiving questions and solutions beyond well-known means. These are considered generic computer elements being used to make the kind of calculations it was invented to make (*Schlumberger*). These features are therefore not considered to be part of the actual invention, which is directed to an abstract grading algorithm.

[54] With regard to the features relating to improvements on computational efficiency of the claimed algorithm, as explained above, there is no evidence that the claimed algorithm improves efficiency compared with known grading methods.

[55] With regard to the “partial marks” feature, as explained above, it is directed to improvements on the grading algorithm, not on the computer. Although this feature might improve the results of grading in terms of accuracy and flexibility, it does not improve the functioning of the computer.

[56] Therefore, the proposed claims would not change the identification of the skilled person, CGK, and the actual invention. Accordingly, the proposed claims cannot be considered to be a “necessary” amendment under subsection 86(11) of the *Patent Rules* because they do not comply with either subsection 27(8) or section 2 of the *Patent Act* for the reasons stated above.

RECOMMENDATION OF THE BOARD

[57] In view of the above, I recommend that the application be refused on the ground that all claims on file are directed to non-patentable subject-matter, which is prohibited under subsection 27(8) of the *Patent Act* and falls outside the definition of “invention” in section 2 of the *Patent Act*.

[58] Further, the proposed claims do not overcome the non-patentable subject-matter defect and therefore the introduction of these claims does not constitute a “necessary” amendment pursuant to subsection 86(11) of the *Patent Rules*.

Liang Ji

Member

DECISION OF THE COMMISSIONER

[59] I concur with the findings of the Board and its recommendation that the application should be refused because claims 1 to 34 on file are directed to non-patentable subject-matter, which is prohibited under subsection 27(8) of the *Patent Act* and falls outside the definition of “invention” in section 2 of the *Patent Act*.

[60] Therefore, in accordance with section 40 of the *Patent Act*, I refuse to grant a patent for this application. Under section 41 of the *Patent Act*, the Applicant has six months to appeal my decision to the Federal Court of Canada.

Virginie Ethier

Assistant Commissioner of Patents

Dated at Gatineau, Quebec,

This 8th day of September 2021