INTELLECTUAL PROPERTY PROTECTION FOR SOFTWARE

Article

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The Disclosure Requirements of Software Patents: Suggestions for Developing Countries

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Abstract: This is a research study of available options of Intellectual Property (IP) protections for software in the present IP systems, in most of the countries including copyright and patent protection. Each type of IP protection has its own advantages and limitations like enablement of subject matter for registration requirements, scope of rights conferred and period of protection etc. The trends and demands of software industry for the grant of patents protection for Computer Implemented Inventions (CIIs) were also discussed. The present research paper discusses a best mode of technical disclosure, more than an algorithm, of software patents and additional recommendations are also given as a solution to the technical problem of a suitable IP protection for software. A *sui generis* IP protection was suggested as a best option for a composite IP protection covering all aspects of advanced software inventions.

Keywords: software patent; disclosure requirement; sufficiency of disclosure; computer implemented inventions; CIIs; computer program; global trends

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Contents

I. Introduction

Intellectual Property (IP) rights protection has been recognized as an assurance to the capital investment on Research and Development of technology. IP rights are exclusive rights granted by the State over intellectual creations including technological inventions, in almost all fields of arts and science. The software industry is also ranked as one of the major players in the advanced and rapidly developing technologies in the world. This industry has a key influential economic impact due to a notable share in market investments and profits.

The available IP protections for software in the present IP systems of most of the countries are copyright and patent. Patent right is considered as the strongest protection among all types of IP protection; however, it has a limitation of period of protection as compared to term of copyright. Each type of IP protection has its own advantages and limitations like enablement of subject matter for registration requirements, scope of rights conferred and period of protection etc. The significant role and contribution of software industry, in national economy of the developed countries, has enabled patent protection for computer program or software in a direct or indirect way by introducing new terminologies. However, the software industry of the developing countries is still facing challenges to get patent protection. The most of IP offices of these countries are reluctant to accept software as patentable subject matter for certain legal restrictions. The standard patentability requirements of an invention include novelty, inventive step, industrial application (Utility), subject matter enablement and technical disclosure of the invention. One of the main reasons for rejection of software patents given by IP offices, is insufficient disclosure of novel technical contribution.

This research is focused on the minimum level of disclosure of newly developed software, considered as an invention. The enablement of software patenting with clear patentability criteria will be a contribution to the economy of developing countries. Canfield (2006, p. 1) discussed two approaches including “Do existing disclosure requirements require applicants to disclose their code? If not, should

the disclosure of code be required under a new disclosure requirement? Kenneth Canfield discussed with respect to United States of America's polices and decisions by the United States Patent and Trademark Office (USPTO) and U.S. courts known as the Federal Circuits and the Supreme Court. The present research paper covers a study about the best mode technical disclosure for software patents in international prospectus and additionally recommendations are given as solutions to the technical problem of a suitable IP protection for software.

A more comprehensive study of patent disclosure requirements with respect to software engineering requirements is suggested here with a newly identified techno-legal approach. The adopted methodology of this qualitative research study is based on international IP laws, case laws, court decisions and recent research studies including research articles, blogs, books, and online web resources on the subject. The research objective is to identify the minimum technical characteristics of a software to be disclosed in the patent application to satisfy the discourse requirement of the Patent Laws which will enable a person skilled in the art to re-engineer the software from the disclosure given in the patent specification. The discussion on available IP rights protection for software in the existing IP systems is given in Part II and international approaches for software protection is given in Part III of this research paper. Part IV substantiates that technical disclosure is the objective concept of grant of patent, Part V encamps the general requirements for software re-engineering with respect to a variety of software technologies and a debate on software in Part VI and disclosure requirements in IP context is made in Part VII. The Limitation for software patents is discussed in Part VIII and the conclusion is made in Part IX by identification of the minimum standard disclosure requirements for software patent protection satisfying the software re-engineering requirements.

II. Intellectual Property Protection for Software

International intellectual property treaties like the Paris Convention for the Protection of Industrial Property,[1] 1883; the Berne Convention for the Protection of Literary and Artistic Works,[2] 1886; and the Trade-Related Aspects of Intellectual Property Rights (TRIPS),[3] 1995 recognize the ownership rights of intellectual creators. Article 27 of the TRIPS Agreement enables patent protection for inventions of all fields of technologies without discrimination subject to fulfillment of patentability requirements. However, Art. 10 of TRIPS provides copyright protection for computer programs. Software engineering also involves a notable investment of resources in terms of capital, time and effort of the skill set like cost incurred on innovation of other technological disciplines e.g., medicines, biotechnology, engineering, or robotics.

Keeping in view the significant role and contribution of software industry in the country's economy, the developed countries has enabled patent protection for computer programs or software in an indirect way by using terminologies like *computer related inventions*, *computer implemented inventions (CIIs)* and *system* etc. However, the software industry of the developing countries is still facing challenges to get patent protection. The indigenous software industry of the developing economies must be supported by a suitable IP protection like strong patent protection instead of copyright and by its effective enforcement. The enablement of software patenting regime will be a value addition to the economy of developing countries' economy like Pakistan, Malaysia, and Turkey.

Technical disclosure of an invention, applied for patent, is a mandatory requirement in addition to basic patentability criteria

[1] Paris Convention for the Protection of Industrial Property. Available at: https://www.wipo.int/treaties/en/ip/paris/ [Accessed 11.02.2024].

[2] Berne Convention for the Protection of Literary and Artistic Works. Available at: https://www.wipo.int/treaties/en/preparatory-documents.html#accordion__collapse__03_a [Accessed 11.02.2024].

[3] Trade-Related Aspects of Intellectual Property Rights (TRIPS) is an agreement by Members of World Trade Organization (WTO) in 1995. Available at: https://www.wto.org/english/docs_e/legal_e/27-trips.pdf [Accessed 11.02.2024].

i.e., novelty, inventive step, and industrial application. The main reasons for rejection of software are insufficient technical disclosure and lack of industrial applicability in most cases. The required level of technical disclosure of a software invention is satisfied with the disclosure of source code. The objective of the research is to identify the minimum characteristics features of a software to be disclosed to satisfy the discourse requirement of the patent laws of a state. The extent of technical disclosure means sufficient description of technical characteristics features provided in the patent specification that enables an ordinary person skilled in the art to develop or re-engineer the patented software.

II.1. Software Technology

A computer program or software is a written set of instructions commonly known as *source code*, to perform a specific operation by controlling computer hardware. This *source code* comprises of written commands in specific format which are translated into *object code* to be read by a computer machine hardware. Software is commonly divided into three categories including *system software*, *programming software* and *application software*. The Graphical User Interface (GUI) or front-end view is result of execution of software's source code at backend. The concepts of "*software as such*," "computer implemented inventions" (CIIs), "*computer related inventions*" and "business method" are used for IP protection. The source code or executable code or application software is regarded as "*software as such*." The term of CIIs is defined in European Patent Office (EPO) Guidelines for Examination, as one which involves the use of a computer, computer network or other programmable apparatus, where one or more features are realized wholly or partly by means of a computer program[4] (EPO, 1978). The inventions, combination of software and hardware, are known as "computer related inventions." The concept of software is further discussed in Part V of this research study.

[4] EPO examination guidelines. Available at: https://www.epo.org/law-practice/legal-texts/html/guidelines/e/j.htm [Accessed 11.02.2024].

II.2. Copyrights for Software

Copyright protection is given for original works of authorship to authors for creativity of artistic work, literary work, audio-video performances like music or movies or dramas, and certain other creative works. The copyright holder has exclusive rights over his work to exclude others from making copies, reproduction, distribution and making derivative work like performing work in public without his/her authorization.

Software in the form of source code, object code or application software are considered literary work. Software codes are like statistical formulas or mathematical equations like algebraic expressions written in books or articles. The computer program was considered a literary work and was covered under copyright protection under the Bern Convention and under Art. 10 of the TRIPS Agreement.[3]

Copyright registration is voluntary and provides a relatively longer term of protection, which is valid up to the author's life plus 50 years thereafter and in some regions, it is up to 70 years after the author's life. The copyright only protects the expression of an idea but not the technical concept or transformation of an idea. Copyright does not protect technical innovative aspects or ideas underlying the software. The duplication of copyrighted ideas by different implementation methods is legally allowed. The concept of copyright infringement for software is weak for example, if graphical user interface, the front end, is changed and the rest of source code is same, it does not amount to a copyright infringement.

The rapid development of technology, especially in the massive use of software applications in all fields of life like home appliance, communication technology and industrial automation, has raised challenges for copyright protection for software. A literary work like a book only comprises printed pages without any extended function of implementation like a software which produces an extended different display or outputs on the execution of code based on runtime data inputs. There is a hot debate nowadays that copyright is not sufficient and does not fit IP protection for advanced technological inventions of software. Copyright protection for "software *as such*" is a widely

accepted approach. However, a demand for stronger IP protection, by the time, has been increased by the industry for complex software application, for example robotics, applications of artificial intelligence, CIIs and computer related inventions.

Copyright protection has a limitation of authorship of creation. The natural person can be an owner of copyright work and term of protection is related to the author's life. Another aspect is related to the rights of the owner due to his/her copyright work. Open-source software, software created by cloud computing and intellectual creations as a result of software, are facing a challenge of clear ownership. The issues of determination of terms of protection and related rights, due to unclear authorship, are obstacles for the grant, to claim and enforcement of copyrights.

II.3. Why is Software not Patented?

Patent right is considered as the strongest protection among all types of IP protections. It provides exclusive rights or monopoly rights over an invention with a limited protection period of twenty years. Article 27 of the TRIPS Agreement, enables patent protection and states that patents shall be available for any inventions, whether products or processes, in all fields of technology, if they are new, involve an inventive step and are capable of industrial application. Although software engineering is a well-recognized discipline of engineering, the developed software is not covered globally under patent protection. A software is the transcription of a mathematical function and math is not patentable. Hence the software is not patentable. Software triggers patent thickets enhancing, difficulty of innovation, complicated cross-licensing relations among stakeholders, and discouraging newcomers in the software industry. Further copyright already provides sufficient protection to keep running the innovation cycle, so software has not been considered for patent protection till now. Patents are exclusive rights granted by the state for inventions subject to its technical disclosure. Software "*as such*" is not considered as a patentable invention and is disqualified for award of a patent mainly for the reason of insufficient disclosure as developed source code is not shared in patent specification.

II.4. Why is Source Code not Disclosed?

Despite complete technical disclosure, the reproduction of a patented technology product is not so simple. In addition to technical disclosure for technology products other than software, a lot of resources including infrastructure, raw materials, skilled labor, and administrative approval are mandatory requirements that cost a notable financial investment. In the case of software invention, where source code is disclosed, only execution by software developer is required, saving all other reproduction costs. Therefore, software industry or developers are reluctant to share source code or object code of their software, contrary to patent holders of other technologies. On the other hand, the software industry demands protection of a technical idea of their software as an invention. The influential giant software industries succeeded in patent protection in some countries even without source code disclosure. Software "*as such*" is excluded from patent protection almost all over the world. However, software under the cover of such terminology as "CIIs" are used in Europe, "computer-related inventions" — in Japan and "systems" term — in some other countries. U.S. has a more relaxed approach toward award of software patent and grant for business methods patents started after the 1998 case of *State Street Bank & Trust Co. v. Signal Financial Group, Inc.* (Keeley-Domokos, 1999).

II.5. Software as Trade Secret

The undisclosed information of commercial value are protected under the legal cover of trade secret laws. Article 39 of the TRIPS Agreement provides protection of undisclosed information against unfair completion subject to three conditions including (1) the undisclosed information has a commercial value and (2) is not readily accessible or open to persons of relevant circle and (3) reasonable measures have been taken by the lawful owner to keep the information secret. However, the main challenge is the secrecy of undisclosed information while launching the product in the market and the control of secret information among employees during production. The lawful owner is responsible for maintaing the secrecy of such information under the law. If information is revealed by an employee or by a third party due

to efficient reverse engineering techniques, this IP protection is ended automatically. The lawful owner of a trade secret can claim penalty or damages from his employee as a breach of contract if the employee is under the "Non-Disclosure Agreement (NDA)," but the owner cannot claim any compensation from a third party at the disclosure of secret information. However, the trade secret is over.

The undisclosed information of commercial value like a technical formula, design of product, business practice, technical process, legal instrument, pattern, customer list, business method and compilation of information can be protected as a Trade secret to get competitive advantage over business competitors (Lin, 2012, p. 940). Trade secret protection, subject to availability, can be adopted as an option for software IP protection. Software itself qualifies for trade secret protection as it is a compilation of information whether is a method of doing business or process of technical operation. Trade secret law is enforced in many jurisdictions including American States and Europe. However, limitations of trade secret are applicable on software and strong measures against decoding or reverse engineering techniques should be adopted with due care.

III. International Practices for Software IP Protection

All the member states of the TRIPS Agreement are obliged under Art. 10 to protect computer programs (software) under copyright protection by grading the source code or object code as a literary work. Despite signatories to the TRIPS Agreement, customized approaches of software protection were observed by the Members States. A most suitable and friendly approach for their national economic growth was adopted for protection of software in order. The objective was to support their software and computer-related industry. Accordingly, the national IP laws were amended by introducing enabling provisions for software protection as the results of industry demand, government policy directives and decision by the courts of law. The practices of some countries, the adoption with respect to software protection and its impact, are discussed here. The countries are categorized here as Developed IP economies and Developing IP economies for the sake of comparative analysis.

III.1. Developed IP Economies

The countries with a higher share of intellectual economy have scored a remarkable positive impact in their national economy with extended IP protection for software. The relevant amendments in national IP laws, national IP office practice, decisions of the courts of laws, application filing trends and overall impact are discussed here. The trend of filing patent applications is increasing rapidly worldwide. The application filed for patent in computer technology and IT method for management collectively reached from 123,283 to 144,053 to 229,277 during the year 2005, 2010, and 2015, respectively (WIPO, 2017, p. 64).[5]

United States of America. Software *as such* is recognized as a "literary work" and is protected under copyright protection under Copyright Law of the United States and Related Laws of the United States Code of the Copyright Act, 1976 (U.S.C. Copyright law).[6] U.S. Copyright protection is meant only for software code and protects against exactly coded software. Internationally copyrights are automatically created over original intellectual creations, for whoever created it, even without registration. However, under the U.S. practice, registration is required to enforce copyright work against piracy or violations. The software industry of U.S. is very strong and has an influential impact on the national economy. In terms of most revenue earning ranking, several world top revenue earning information technology firms, belongs to the U.S. including Apple Inc., Alphabet Inc., Amazon, Microsoft, IBM, Intel, and Dell Technologies.[7] The significant economic impact of this industry leads the software to a stronger IP protection in the U.S. According to another view, it can be said that the policy of relatively stronger IP protection for Information and Communication Technology (ICT) products played a key role in flourishing of the U.S. based IT firms.

[5] World Intellectual Property Indicators. (2017). Fig. A32. P. 64. Available at: http://www.wipo.int/edocs/pubdocs/en/wipo_pub_941_2017.pdf [Accessed 11.02.2024].

[6] Copyright Law of the United States and Related Laws of the United States Code. Available at: https://www.copyright.gov/title17/title17.pdf [Accessed 11.02.2024].

[7] Wikipedia. List of largest technology companies by revenue. Available at: https://en.wikipedia.org/wiki/List_of_largest_technology_companies_by_revenue [Accessed 11.02.2024].

The ICT sector has a major impact on the U.S. economy. The ICT sector provided jobs for up to 4.2 million workers in 2002 and contributed a share of $ 1 trillion to the national GDP, i.e., 7.4 % of GDP (CEO Council, 2014). Software is also recognized as an invention and is eligible for patent protection under the U.S. law. Patentability of an invention is stated under 35 U.S.C. § 101 of U.S. Patent Act[8] where a patentable invention includes any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, subject to the conditions and requirements of the title (U.S. Patent Act). Patentability of software inventions are judged on two parameters, i.e., physicality or utility, under the Manual for Patent Examination Procedures (MPEP) guidelines of USPTO and in the light of U.S. Federal Circuit decisions. "Physicality" aspect of a software invention covers disclosed software, which results in a physical transformation outside the computer while "utility" aspect of a software invention itself relating to a practical application software as a new process invention. However, disclosure requirement for a person skilled in the art (PSA) is relaxed as either disclosed in the specification or would have been known to a skilled artisan as referred in USPTO Manual of Patent Examining Procedure[9] (MPEP). In software patents, the algorithm of software application is described in the specification as disclosure especially for the software with "utility" aspect, which is supported by the decision of U.S. Court (Trs. of Bos. Univ. v. Everlight Elecs. Co., LTD., 896 F.3d 1357, 1364 (Fed. Cir. 2018)[10] and the Section Guidance 112 (USPTO MPEP). An algorithm is a step-by-step procedure for solving a given type of technical or mathematical problem. The disclosure of software source code is not required according to the USPTO examination practice and U.S. Federal Circuit's patent law interpretation (Canfield, 2006, p. 7). A dramatic increase was observed in patent filing in the U.S. after the

[8] Available at: https://www.bitlaw.com/source/35usc/101.html [Accessed 11.02.2024].

[9] Manual of Patent Examining Procedure § 2106, United States Patent Office, Ed. 9, Rev. Available at: https://www.uspto.gov/web/offices/pac/mpep/index.html [Accessed 11.02.2024].

[10] Available at: https://casetext.com/case/trs-of-bos-univ-v-everlight-elecs-co-27 [Accessed on 11.02.2024].

court's decisions for the grant of patent protection to software (Hunt, 2001, p. 8) and business methods.[11]

Europe. The term "program code" or program listing is alternatively used for software "*as such*" in practice at the European Patent Office (EPO). Program codes are protected under copyright protection, which covers only the expression and implementation of a particular program code but not the idea or a business method behind it. Optional protection of copyright like international practice is also available in the European region. Computer programs are not graded as inventions under Art. 52(2) c of European Patent Convention (EPC).[12] However, under the EPO practice, a new solution which solves a technical problem qualifies as a patentable invention. Software inventions are granted patent protection by measuring at abovementioned criteria of a problem solution approach. Software inventions are patented in most of the EU countries by using the terminology of Computer-Implanted Inventions (CIIs). CIIs are classified into three categories in the EU practice. First, the software which controls the devices by microprocessor like pure machine software, e.g., Programmable Logic Controller (PLC), embedded software; the second type is software-controlled processes like software controlling industrial automation by using computer or microprocessor; the third type is software "*as such*," if has any technical effect that goes beyond normal interaction of software and computer hardware (Frietsch et al., 2015, p. 5). The application filing of CIIs has been increased at the EPO from mid-1990s and in 2002, CIIs filing reached more than 35 % of all filings at the EPO in 2011[13]. However, the shares of CIIs based application filed U.S. and Canada were higher than the EPC Member States in total applications (Frietsch et al., 2015, p. 19). This positive impact of increased filing of CIIs indicates its significance in economic growth. The CIIs related industry has created a notable share in jobs creation in Europe.

[11] Available at: https://www.philadelphiafed.org/-/media/frbp/assets/economy/articles/business-review/2001/q1/brq101bh.pdf [Accessed 11.02.2024].

[12] Convention on the Grant of European Patents (European Patent Convention). 1973, Rev. 2000, Available at: https://www.epo.org/en/legal/epc/2020/a52.html [Accessed 11.02.2024].

[13] https://www.4ipcouncil.com/application/files/1314/5277/3742/Economic_impact_of_CII_at_EPO.pdf [Accessed 11.02.2024].

China. The current Patent Law of China does not clearly recognize computer programs as a patentable invention. However, computer-related inventions are not excluded from patent protection under this law. As per SIPO practice of patent examination guidelines, computer-related inventions are judged to grant a patent, where combination of software and hardware collectively creates a technical effect (Zhou, 2006, pp. 135–136). Copyright "*as such*" or a mere program code is excluded from patentability and protected under copyright in China.

Japan. Japan Patent Law, after amendments in 2002, clearly enables patent protection for computer-related inventions as a computer product. The one of the basic criteria for patentability of a software invention is determined whether a creation of technical ideas utilizing a law of nature. Japan Patent Office (JPO) has issued special guidelines for examination of computer software-related inventions.[14] Japanese patent law divides software into three categories, including software in combination with hardware; software on computer-readable storage medium and explicit software as patentable inventions if the information processed by software is concretely realized by using hardware resources. However, disclosure of computer program code is not required for computer-related inventions.

III.2. Developing IP Economies

The countries with developing intellectual economies shy away from granting patent protection to software. Despite this a notable litigation is going on in these countries, but the matter of granting patent to a computer program remained a challenge. Three case countries studies are listed here to assess the situation on the subject issue.

Turkey. Computer programs or software "*as such*" in accordance with Art. 55 and 82 of Law No. 6769 on Industrial Property Code,[15] are excluded from patent protection in Turkey. A similar approach to EPO,

[14] Computer software-related invention. Available at: https://www.jpo.go.jp/e/system/laws/rule/guideline/patent/handbook_shinsa/document/index/app_b1_e.pdf [Accessed 11.02.2024].

[15] Available at: https://www.turkpatent.gov.tr/en/laws-and-regulations [Accessed 11.02.2024].

towards granting patent protection for software, has been adopted by the Turk Patent and Trade Office. A software-related invention can be patented in Turkey like in the EU, if it is related to a machine or process and qualify for other patentability requirements. However, disclosure requirement is limited to sharing a software algorithm only. There is a need for clear definition of software as a patentable invention in IP code with more precise disclosure requirements.

India. The Indian Patents Act, 1970, amended in 2002,[16] excludes software from patent eligibility. Section 3(k) of the Patents Act states that inventions in the form of a mathematical or business method or a computer program per se or algorithms are not patent eligible. This legal statement means a computer program "*as such*" and even described in the manner of a software algorithm cannot be patented. However, as per practice of the patent system of EPO, US, and Japan, computer programs are patented, and software algorithms are given in description as a technical disclosure. An effort was made in 2005, for amendment to enable patent protection for *computer program with technical application to industry*, was turned down by the Indian parliament (Eberhardt et al., 2016). Despite this, a computer program per se or algorithms are excluded from patentable subject matter, still several patents for software inventions are filed every year in India and several software inventions succeed to get a patent because they are cleverly drafted by using alternate terminologies. Software in the combination with hardware is considered as patentable in India also. Contrary to developed IP economies, this exclusion of a stronger IP right for a computer program adversely affects national software industry.

Pakistan. Computer programs as such or software applications are protected under copyright protection in Pakistan. Pakistan's IP laws were revised in 2000, in compliance with the TRIPS Agreement. Accordingly, computer programs were kept under copyright protection. Section 7(2) of the Patents Ordinance (2000)[17] excludes mathematical methods,

[16] The Indian Patents Act, 1970, amended 2002. Rev. Available at: https://ipindia.gov.in/writereaddata/Portal/IPOAct/1_113_1_The_Patents_Act_1970_-_Updated_till_23_June_2017.pdf [Accessed 11.02.2024].

[17] Available at: https://ipo.gov.pk/system/files/%28112%29PatentsOrdinance2000_Amendmentsfinal_0.pdf [Accessed 11.02.2024].

literary work, business methods and presentation of information from the definition of an invention. As per present practice at IPO Pakistan, the Patent office rejects software inventions by giving equivalence to one of above-mentioned excluded categories from the patentable subject matter. However, under IPO Pakistan's practice, software in the combination with hardware like machine software are granted patent protection. This non-supportive policy towards software patenting is one of the reasons for a very low number of applications filing for software inventions in Pakistan. However, national software industry demands are increasing for patent protection for their investments in this technological field of inventions.

IV. Patents as Monopoly Rights

A patent is sort of a mutual agreement between a sovereign State or government and the inventor or legal assignee of an invention. The State, under this agreement, grants exclusive rights to the inventor over its invention for a limited period in exchange for detailed public disclosure of his/her invention. In legal terms, a new or improved solution to a specific technological problem, whether a product or a process, is defined as an invention (WIPO, 2008).[18] The core aim of patent protection is to promote scientific research and development in all fields of technology for the betterment of mankind. A balance is maintained by granting exclusive rights to investor or investor over their novel product or process, to ensure their investment on research, in exchange of public disclosure of their invention. The detailed public disclosure enables the researchers of the field to continue further research on the invention which saves the cost resources on re-inventing the wheel. This patent system attracted the intellectuals to share their knowledge of highly valuable research results and tangible achievements. The patent is also commonly regarded as monopoly rights. However, this concept is not true in totality, for the reasons several constraints are still applicable

[18] WIPO Intellectual Property Handbook: Policy, Law and Use. (2008). Chapter 2: Fields of Intellectual Property Protection Archived 2013-05-20 at the Wayback Machine. Available at: https://bae2008.files.wordpress.com/2015/02/wipo_pub_489.pdf [Accessed 11.02.2024].

despite grant of patent. For example, these constraints include: patent is only granted for a limited period of time, i.e., for 20 years, patent is enforceable only within the jurisdiction of a State where it was granted, filing an application before public disclosure is mandatory, patent cannot be granted without fair disclosure, exploitation of patented, 100 % market monopoly does not allow other laws to be applicable, and a State can use invention without the consent of a patentee by issuing compulsory license in special conditions, e.g., emergency health situations, etc. TRIPS Agreement allows the Member States to include several exceptions to grant of patent which are in their national interest with certain limitations.

IV.1. Non-Patentable Subject Matter and Non-Inventions

Patents are granted for the inventions and most countries of the world including EPC excluded the following intellectual creations from the definition of a patentable invention in national patent legislation. These non-inventions are non-patentable subject matter and include a discovery, a scientific theory, a mathematical method, purely aesthetic work like creative or artistic work, a scheme, playing a game or doing business, a rule or a method for performing a mental act, the presentation of information; a computer program or a code *as such* and simple isolation of substances that exist in nature.

IV.2. Exceptions to Patent Protection

Several inventions which even qualify for patentability criteria are still barred for patent protection under the pre-defined exceptions in the patent laws of the respective jurisdiction. For example, some inventions are excluded from patent protection such as inventions against public order or morality or prejudice to health of living organisms or the environment; inventions of new plants and animals other than micro-organisms; inventions for essential biological processes for the production of plants or animals other than non-biological and microbiological processes; inventions for therapeutic, diagnostic, and surgical methods for the treatment of humans or animals; a subsequent use of a known

process or product; and for a mere change in physical appearance of a chemical product. In general practice, software, computer program, computer listing, software codes, source codes, application software and "software *as such*" are considered as non-invention subject matter and excluded from patent protection.

IV.3. Technical Disclosure as mandatory "Patent Requirement"

According to Art. 29 of the TRIPS, *"Members shall require that an applicant for a patent shall disclose the invention in a manner sufficiently clear and complete for the invention to be carried out by a person skilled in the art and may require the applicant to indicate the best mode for carrying out the invention known to the inventor at the filing date."* This means that an invention applied for a grant of patent must be disclosed with detailed technical details in the description, up to such a level that a person skilled in this relevant field of technology can understand it and reproduce the patented invention whether product or process. According to Section 112 of the U.S. Patent Act, the patentee is required to clearly explain their claimed invention and the procedure how to make and use the invention, in the written description (U.S. Patent Act). Article 83 of the European Patent Convention (EPC) states that a European patent application must disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art. However, the level of expertise of a person skilled in the relevant field of technology varies from one field of technology to other field of technology and sometimes from jurisdiction to jurisdiction. The patent disclosure is published by the national IP office for public information before the grant of the right. In this way the technical knowledge is disseminated in public and enters public domain after expiry of patent rights, if granted. The detailed disclosure of patented invention for public information is binding to enjoy benefits of exclusive rights.

V. Software Engineering

Software engineering is a common term for the design and development of software applications in a systematic manner. According to the definition by the Bureau of Labor Statistics, software engineering is a *"systematic application of scientific and technological knowledge, methods, and experience to the design, implementation, testing, and documentation of software…"* (ISO/IEC/IEEE, 2010).[19]

V.1. General Requirements in Respect of Software Engineering

Several development models, approaches, designing tools and platforms are available for designing and development a software application. The most appropriate or suitable model, design tool and platform are selected by the developers because of system requirement analysis. This selection depends mainly on technical, functional software requirements, required time of development, development and maintenance cost, customer, or end user needs, and availably of skill set in the market, etc. These requirements are recorded in the System requirements specification (SRS) as functional and non-functional requirements. A standard software development requires at least, an algorithm, a text editor for coding, a programming tool, Flowchart, database structure, database modeling tool, ERD, and networking protocols services etc. Computer programs can be divided into three main categories, i.e., application software, programing software and system software. A programming tool or language is *programming software* is a coding tool for developers to write source code e.g., C#, Java, JavaScript, Scala, HTML, XML, PHP, SQL, Oracle, Ruby, Swift, CSS, Kotlin, Rust, etc. are few examples of commonly known programming languages. *System software* are coded in machine languages and includes device driver, operating system (OS), compiler, disk formatter and simple text editor etc. System software serves as a base for application software as middleware between application

[19] Definition of Software engineering. Systems and software engineering — Vocabulary, ISO/IEC/IEEE std 24765:2010(E), 2010.

and computer machine. *Application software* is high level computer applications designed to perform certain tasks for non-technical end users like database systems, gaming applications, office suites, business software and educational software, etc. Some application software can be platform dependent and platform independent. An operation of computer software is a composite result of execution of *application software* written in a *programming language* and based on *system software*.

During the designing phase of Software Development Life Cycle (SDLC), specific programming software, database structures, inter-operability tools, protocols, application server, and modeling language are selected. Specialized tools have been designed for each type of application software, for examples PHP,.Net, or AJAX are commonly used for the development of a website of browser base applications. The right selection of tools increases operational efficiency and performance of software. Open-source programing software is very popular among developers. However, full-sized firms prefer to use licensed software applications due to the advantage of backup support.

The software design process includes designing algorithms, UML, flow charts, database design and connectivity. The transformation of an algorithm or a flow chart, with all constraint, is done by a coding process and its connectivity to designed database. Coding is not a simple process; it requires multiple times improved coding and regressive testing. Like introduction of Object-Oriented Programming technique, reusability of code, brought revolutionary increase in software coding techniques and application efficiency, in the past. Ideally, for re-engineering software, the sharing of programing logic, language, tools, database structure and technical user documentation makes the programmer's life easier. However, sharing a software source code only requires execution of the code at proper platform.

V.2. Software Engineering vs Other Engineering Disciplines

Patents are available for all types of technology; therefore, software engineering must qualify to be an engineering discipline to be eligible for a patent. Many experts consider that software engineering is not

a real engineering discipline like other real engineering disciplines of civil, mechanical, electrical, electronic, or industrial engineering, etc. This school thoughts supportive to the above approach argues that other engineering disciplines produce some tangible and durable results, based on laws of nature, in the form of products. Most other engineering disciplines involve cross-disciplined works. However, software engineering is performed in a totally artificial environment without involvement of cross-disciplinary tangible components. According to the second approach software engineering is considered as "a systematic approach to the analysis, design, assessment, implementation, test, maintenance and reengineering of software, that is, the application of engineering to software" (Phillip, 2007, p. 1). Disclosure requirements of an invention for grant of a patent varies from discipline to discipline. For example, some additional requirements are required in following types of invention listed below:

1. drawings in device and mechanical inventions,
2. block diagrams or process flow diagrams in process or procedural invention,
3. structural formulas in chemical products,
4. DNA sequences or genes listings in most of Bio-tech inventions,
5. efficacy data in case of subsequent use of pharmaceutical invention.

V.3. Determination of an Inventive Step for Re-engineered Software

A patent is granted for an invention if the claimed invention qualifies for the legal requirement of novelty and inventive step over prior art and is capable of industrial application or utility. An invention has an inventive step if it was non-obvious to a person skilled in the art (PSA) before or at the time of filing of the patent application for this invention. Mostly new inventions are granted patents based on an inventive step. However, there is not any standard scale of qualification of inventive step. It depends upon the examiner approach for the level expertise of PSA. The knowledge level of PSA varies from technology to technology. In the case of software re-engineering, the judgement of an inventive

step over existing software would not be simple. Software engineering encamps a wide range of tools and technologies. The software invention can be a collective result of multiple experts of various tools, used in single software application. Therefore, multiple PSA will be considered to judge each technological aspect of software application. The level of expertise and understanding for each programming tool is different even within the same software engineering discipline as the concept of an "informed user" varies from market to market in Trademark cases. For the improvement of efficiency of software invention only minor code level changes are made. Whether this minor change in code will qualify for an inventive step or not? However, inventions qualify for inventive steps in case of improved efficacy in medicines or pharmaceutical inventions.

VI. Role of Software Applications

The application of software has become a significant component of all technological products. A huge investment is being made in research to offer competitive and efficient products. The software development in each sector requires different levels of expertise, varieties of tools used, and a focused approach with a specific research direction. Few examples are discussed below.

E-Commerce: software application designed using high level programming language to deploy business methods and schemes with additional information security measures like using network protocols and encryption techniques. This development enabled online banking and online sale of goods.

Machine Software: system software is coded to control hardware operations and performance which include computer parts drivers, industrial automation software, PLC, applications for automotive industry etc.

Telecommunication Industry: the development of mobile phone applications is hot cake due to recent trends of increased use of mobile phones. These mobile applications involve Artificial Intelligence (AI) software for ease of use and their use has become an integral part of daily life. These software apps are considered as "an edge" for sale

of mobile phones. Software applications enabled efficient, fast, and economical voice and video call options.

Communication Technology: system software is used as networking and communication protocols for efficient, fast, and secure connectivity. The security levels are achieved by using encryption and decryption techniques and VPN, etc.

Office Business: the business process is computerized by using complex software applications for biometric attendance, accounts, finance, payroll, inventory, procurements, sales recruitments, etc.

Artificial Intelligence (AI): systems and machines are equipped with advanced software applications based on Artificial Intelligence. AI is complex software where operations of machine and decision are controlled by the machine itself based on inputs received from the surrounding environments such as robots, industrial automation machines and 3D Printers.

Cartoon, Movies and Games: complex software applications are used to create cartoon movies, artificial and fiction movies, mix music work, artistic work, and video games, etc. In most cases, AI software is involved in creating intellectual creations by the machines.

Medical Industry: It is a very sensitive but demanding area. The use of application software in combination with system software makes it possible to get inputs from medical devices or sensors and produces calculated results and graphs on Graphical User Interface (GUI). Software applications play a key role in disease diagnosis, performing laboratory tests, patient monitoring, and medicinal research. Result accuracy is a central factor of software development for this sector.

Defense Industry: AI based software applications are being used widely in the defense industry such as missile technology, avionics, drone, and radar, etc. In this case the focused approach of software development is accuracy of geo-positioning.

Web designing platform independent or browser-based applications are developed for websites using special protocols and information security techniques. Email servers are also software applications where the main concern is privacy of personal information and communication. Special programming languages are used to design webpages or portals. Data security against hacking is the main challenge of the day for website development.

VII. Disclosure Requirements for Software Patents

The amount of detailed disclosure is accounted for scope of protection of a claimed invention. Similarly, for a software invention, at least following considerations may be made before defining the sufficiency and completeness of technical disclosure for grant of a patent right.

1. What is to be protected? The subject matter of claims defines the scope of protection.

2. Whether software or computer code is claimed in the set of claims?

3. What is the actual novel contribution in the claimed invention?

4. Who is the Person Skilled in the Art (PSA)? The level of expertise and understanding for each programming tool is different even within the same software engineering discipline like the concept of an "informed user" varies from market to market in Trademark cases.

5. The examination guidelines with multiple approaches for variety of software inventions must be defined for examiners.

6. Whether validation of a source code by the IP office is required before grant of a patent?

7. What would be novelty or similarity search parameters for the examiner?

8. What would be published? Whether publication includes a source code, an object code, software architecture, a front end or GUI, a block diagram, a data flow chart, DFD, ERD, CSS, metadata, data structures, an algorithm, RDBMS, a database structure or schema, cardinality, and software modeling, etc.

9. What would be the scope of rights protection and infringement?

VIII. Limitations and Challenges for Software Patent

Software engineering is an emerging field of technology. Software is being used in almost all sophisticated products from simple home appliances to advanced automated industry machines. The software wide application in various technological fields raised new research questions to be solved as unprecedented challenges. There is no sufficient available

research work in the field of IP protection and intellectual creations during software development. The challenges to be faced to enable the patent protection for software industry are listed below.

1. Software is excluded from patentable inventions under existing International IP Agreements.

2. Adoptability of patent protection due to enforced national IP Laws.

3. Opposition against the sufficient disclosure of a software invention by Multinationals Companies (Giant Software Houses).

4. Ownership issues like a product produced because of cloud computing and for an open-source software.

5. Ownership issue of intellectual creations because of Artificial Intelligence software applications or robots or machines such as painting, pictures, games, cartoon movies, 3D movies, 3D models, etc.

6. Patent enforcement of software patent against copying like cross border pricy including illicit downloading using internet.

7. Determination of inventive step for simple improvements in software inventions. For example, existing similar concepts for other fields of technology are utility patents, incremental patents, or patents of addition.

8. Decision on Term of protection for a software invention whether it should be like a term of protection for patent, industrial design, or copyright.

IX. The Disclosure Requirements for Software IP Protection

IX.1. Software as Computer Implemented Inventions (CIIs)

The computer implemented inventions (CIIs) or computer related inventions may be clearly recognized as technological software inventions and may be covered under patent protection. However, disclosure requirements must be satisfied by sharing technical information's more than algorithm. In this regard, WIPO can play a lead role for the identification of minimum standard disclosure requirements for patent protection of software inventions. All countries of the world may enjoy the advantages of patent protection for software inventions like advanced countries with IP economies.

IX.2. *Sui generis* IP Protection System for Software Protection

Neither patent nor copyright protection is fit for the complex, hi-tech and multidisciplinary software inventions like AI based software application products. Comprehensive IP protection may be offered to protect the rights of the software industry and to encourage research and development in this field. A *sui generis* IP protection system for a software invention will provide complete protection to the technical contribution and creativity and will also address all the limitations for software technology in other IP systems as mentioned above in this paper. A composite IP protection may be given by applying through single application and the scope of protection after registration should include at least following:

1. protection of design of external appearance or GUI as a whole;
2. a composite protection of GUI with a source code;
3. protection of implemented business idea transformed under software;
4. in case of a software code *as such* the offered protection should be like copyright;
5. technological inventions with embedded software should be protected like patent protection;
6. AI software should be considered like other technological inventions and should be protected like patent protection;
7. a minimum standard technical disclosure, more than sharing of algorithm, must be defined by the law and must be given to enable PSA for re-engineering of the patented software invention without an involvement of innovative effort.

X. Conclusion

Emerging technologies and advancement in existing technologies are posing many issues for legal scholars. Intellectual property right protection of software was, is and will remain a bone of contention for legal scholars due to their role in tadeonal computers and now quantum computing. Any IPR protection mechanism may be adopted depending

upon the situation of the country and objectives to be attained. A sui generis system for software protection can be the best option to protect the software and related industries' investment which is also supported by the TRIIPS agreement. This system should grant protection software for novel logic and implementation concept with at least criteria of the novelty, the inventive step, and the minimum standard enablement requirements for PSA. The requirement of industrial application may be excluded in IP protection of the computer program and software related inventions. However, the determination of *inventive step* will remain challenge like other patent cases. It is right of every country to adopt the best mechanism or a combination of mechanisms until it does not violate basic instruments like the TRIPS Agreement, the Berne Convention, and other related IP Acts.

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