Software patents or copyright?

Emerging issues relating to A.I.

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Copyright on software: the law

- Italian law on copyright: Legge 22 aprile 1941, n. 633 (novella 1992)

- Under said law, creative intellectual works belonging to literature, music, figurative arts, architecture, theater and cinematography are protected, whatever the mode or form of expression are protected,

- Computer programs are also protected as literary works under the Berne Convention on the Protection of Literary and Artistic Works, ratified and enforced by the Law of 20 June 1978, n. 399

- Computer programs, in any form expressed provided that they are original as a result of the author's intellectual creation;

- Unless otherwise agreed, if a computer program is created by the employee in the performance of his duties or on instructions given by his employer, he is the owner of the exclusive rights of economic use of the program created.

- The major advantage of copyright protection lies in its simplicity

Copyright on software: the protection
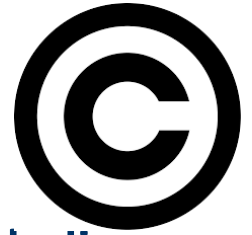
- **The ideas and principles underlying any element of a program, including those at the base of its interfaces, <u>are excluded from the protection afforded by this law</u>. The term program also includes the preparatory material for the design of the program itself**

- **(art. 64-bis) exclusive rights include (*i.e. what is protected is*):**
- a)   **reproduction, whether permanent or temporary, in whole or in part by any means or form; loading, displaying, transmitting, storing,**
- b)   **translation, adaptation, transformation,**
- c)   **distribution to the public**

Copyright on software: what is allowed

- **The backup copy is allowed;**

- **It is allowed: observing, studying, testing and understanding the principles;**

- **The following are allowed: reproduction and translation to make essential changes to interoperability.**

Are you allowed to make a backup copy of software?

A. Yes
B. No

Copyright on software
Italy registration with S.I.A.E.

- Public Register Software : https://www.siae.it/en/autori-ed-editori/the-registers/public-register-software

- To register a program, the applicant must send a "declaration" and a "description" to SIAE more than, of course, <u>a sample of the program to deposit on a write-once digital device</u> (CD-ROM, DVD).

- The request/declaration of registration of a program, on the appropriate form 349), must be sent to SIAE filled and signed in original.

- On the form 349 a virtual stamp duty of € 16.00 charged to the depositor will be placed by SIAE Offices.

- In case authors are more than two, the instructions regarding a third or more authors must be inserted on the back on the form, in the appropriate "integrations" field.

PATENT

Why patents are powerful tools?

broad protection is due to "patent claims"

CLAIMS: DEFINITION

The claims define, in technical terms, the extent, i.e. the scope, of the protection conferred by a patent, or the protection sought in a patent application.

The purpose of the claims is to define which subject-matter is protected by the patent.
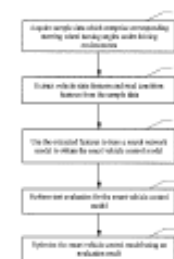
Example: SMART VEHICLE

BACKGROUND OF THE INVENTION

A smart vehicle is a comprehensive system integrating functions such as environmental perception, planning decision and multi-level assisted driving so that the vehicle has a smart environment perception capability and can automatically analyze security and danger states of the run of the vehicle, and so that the vehicle reaches a destination by a person's will and finally achieves the purpose of operating in place of a driver. In recent years, the smart vehicle has become a development and research hot spot in the field of world vehicle engineering and a new motive power for growth of vehicle industry, and many countries introduce it into their respective smart transportation systems for which they put focus on.

Decision-making and control play a crucial role in a smart vehicle driving system, wherein control of a steering wheel is a type of relatively important control. **Current control of the steering wheel of the smart vehicle is mainly based on PID algorithm, i.e., during procedure control, control is performed according to proportion (P), integration (I) and differential (D) of a deviation**. However, when control is performed for the steering wheel of the smart vehicle by using this algorithm, a lot of man power needs to be input for parameter regulation on the one hand, and on the other hand, sensors are substantially relied on.

Example: detailed description

Fig. 1

101 Acquire sample data which comprise corresponding steering wheel turning angles under driving environments

102 Extract vehicle state features and road condition features from the sample data

103 Use the extracted features to train a neural network model to obtain the smart vehicle control model

104 Perform test evaluation for the smart vehicle control model

105 Optimize the smart vehicle control model using an evaluation result

Fig. 2

201 Extract vehicle state features and road condition features of a vehicle to be controlled

202 Input the extracted features into the smart vehicle control model to obtain a steering wheel turning angle

203 Control the vehicle to be controlled using the steering wheel turning angle

Fig. 3

Sample data

01 Sample acquiring unit

02 Feature extracting unit

03 Model training unit

Smart vehicle control module

04 Test evaluation unit

05 Model optimizing unit

Fig. 4

11 Feature extracting unit

12 Turning angle obtaining unit
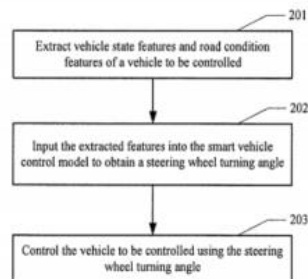
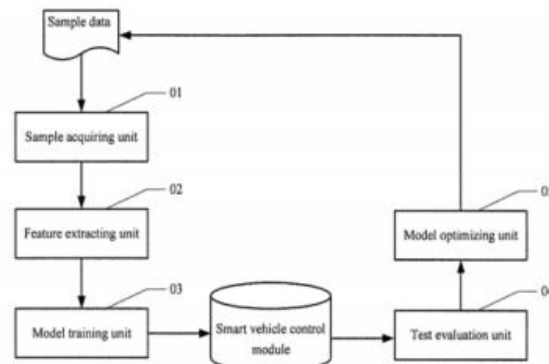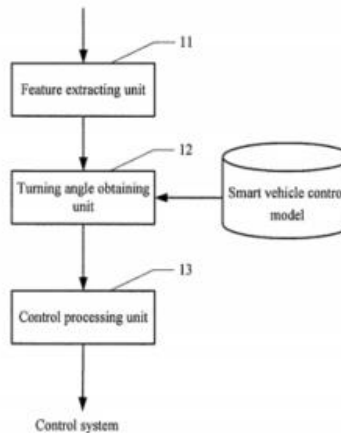Smart vehicle control model

13 Control processing unit

Control system

6

Various neural network models may be employed, such as convolutional neural network (CNN), feedforward full connection neural network (FNN) and the like.

The draining procedure of the neural network model is described briefly as follows:

Data employed upon model training comprise:

1) Features: feature[0], feature[1], . . . feature[5] are used respectively to represent values of the employed six features.

2) Steering wheel turning angle represented by a label.

Normalization processing is performed for the label. Normalization is performed as follows according to a maximum value max of the steering wheel turning angle and a minimum value min of the steering wheel turning angle:

$$label' = (label - min)/(max - min) \qquad (1)$$

wherein label' is the steering wheel turning angle after the normalization.

Normalization processing is performed for features. The normalization is performed as follows according to an average value and a standard deviation of values of features:

$$model\_input[i] = (feature[i] - mean[i])/var[i] \qquad (2)$$

wherein model_input[i] is a value after feature[i] is normalized, mean[i] is an average value of feature[i], and var[i] is a standard deviation of feature [i].

Model parameter matrixes are A, B, C and D, wherein matrix A is a matrix with 6 rows and 128 columns, matrix B is a matrix with one row and 128 columns, matrix C is a matrix with 128 rows and one column, and matrix D is a matrix with one row and one column, wherein 128 refers to the number of nodes in a concealed layer of the neural network. 128 is taken as an example here, or other values may also be taken. The training procedure is a procedure for determining the four model parameter matrixes. Upon onset of the training, the four model parameter matrixes are first initialized, namely, an initial value is endowed to them.

Model training is performed according to the following formulas:

$$layer = tan h(model\_input * A + B) \qquad (3)$$

$$label' = layer * C + D \qquad (4)$$

wherein model_input is a matrix comprised of model_input[0], model_input[1], model_input[2], model_input[3], model_input[4] and model_input[5].

The smart vehicle control model is obtained after the sample data are used to perform the training of the neural network model. Input of the smart vehicle control model is six characteristics, and output thereof is the steering wheel turning angle.

After the above training is completed, the following steps may be further executed to master and improve the precision of the model.
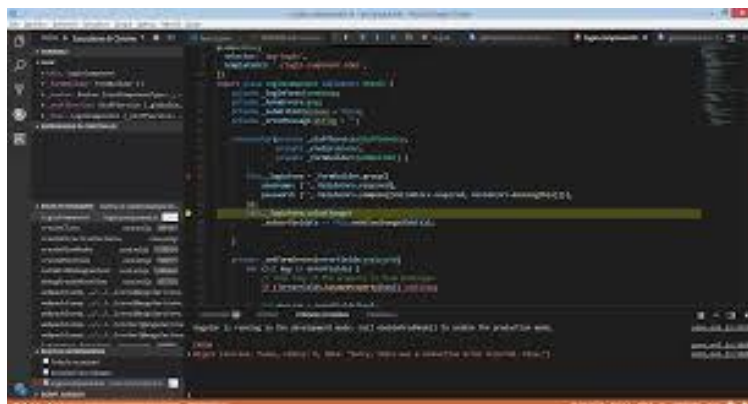
In 104, test evaluation is performed for the smart vehicle control model.

Example

To explain the invention:

- Description: about 5000 words (30 pages)
- Drawings: 4 drawings, showing flowcharts
- mathematical formulas to describe different NN
  and their training.

How many software instructions to implement the method ?

The patent document shown:

(12) **United States Patent**
Yu et al.

(10) Patent No.: **US 10,065,680 B2**
(45) Date of Patent: **Sep. 4, 2018**

(54) METHOD OF BUILDING SMART AND VEHICLE CONTROL MODEL, AND METHOD AND APPARATUS FOR CONTROLLING SMART VEHICLE

(71) Applicant: BAIDU ONLINE NETWORK TECHNOLOGY (BEIJING) CO., LTD., Beijing (CN)

(72) Inventors: Li Yu, Beijing (CN); Tianlei Zhang, Beijing (CN)

(73) Assignee: Baidu Online Network Technology (Beijing) Co., Ltd., Beijing (CN)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 75 days.

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G06N 3/08 (2006.01)

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CPC B62D 15/025 (2013.01); G05B 13/027 (2013.01); G06N 3/08 (2013.01)

(58) Field of Classification Search
CPC B62D 15/025; G05B 13/027; G06N 3/08
See application file for complete search history.

(56) References Cited
U.S. PATENT DOCUMENTS

(57) **ABSTRACT**

The present invention provides a method of building a smart vehicle control model, and a method and apparatus for controlling a smart vehicle, wherein the method of building a smart vehicle control model comprises: acquiring sample data which comprise corresponding steering wheel turning angles under driving environments; extracting vehicle state features and road condition features from the sample data; using the extracted features to train a neural network model to obtain the smart vehicle control model. The method of controlling smart vehicle comprises: extracting vehicle state features and road condition features of a vehicle to be controlled; inputting the extracted features into the smart vehicle control model to obtain a steering wheel turning angle; controlling the vehicle to be controlled using the steering wheel turning angle. The present invention builds the smart vehicle control model in a machine learning manner, does not require manual parameter regulation and reduces man power costs caused by parameter regulation.

18 Claims, 2 Drawing Sheets

CLAIM 1 (US 10,065,680)

A computer implemented method for building a smart vehicle control model, comprising:

a) acquiring sample data which comprises corresponding steering wheel turning angles under driving environments;

b) extracting vehicle state features and road condition features from the sample data;

c) using the extracted features to train a neural network model to obtain the vehicle control model.

BROAD PROTECTION

1) not limited to specific vehicles;
2) not limited to specific sensors or detected parameters;
3) not limited to specific Neural Network typologies;
4) not limited to specific training algorithms;
5) not limited to specific mathematic formulas, configuring parameters, thresholds, or weights,
6) not limited to numerical values
7) not limited to particular electronic circuits
8) not limited to specific software operative systems or languages

Patent protection is very broader than the one offered by the copyright system

Artificial Intelligence

With the latest types of artificial intelligence, the computer program is no longer a tool; it actually makes many of the decisions involved in the creative process without human intervention.

Patent field (invention or industrial design):

- A.I. is employed to design a new compounds
- A.I. is employed to design a new drug
- A.I. is employed to design a new biological entity
- A.I. is employed to define a new control model
- A.I. is employed to design fashion products

Copyright (works)

- A.I. is employed to create specific software (e.g. algorithms)
- A.I. is employed to create specific texts (e.g. new articles)
- A.I. is employed to create portraits (after learning a style)
- A.I. is used to determine the behavior of non-player characters (NPCs) in games.

Emerging issues

Patent field (invention): Who is the inventor?

Copyright (works): Who is the author?

?

The person who designed the Neural Network

The owner of the Neural Network

The user of the NN (e.g. videgame palyer)

The Neural network itself.

COPYRIGHT AND A.I. : Authorship

Most jurisdictions state that <u>only works created by a human</u> can be protected by copyright.

There are two ways in which copyright law can deal with works where human interaction is minimal or non-existent:

A) To deny copyright protection for works that have been generated by a computer.

B) To attribute authorship of such works to the creator of the program.

Another issue:

Should the law recognize the contribution <u>of the programmer</u> or <u>the user of that program?</u>

Granting copyright to the person who made the operation of artificial intelligence possible seems to be the most sensible approach.

Such an approach will ensure that companies keep investing in the technology, safe in the knowledge that they will get a return on their investment.

*By **Andres Guadamuz**, Senior Lecturer in Intellectual Property Law, University of Sussex, United Kingdom*

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PATENT AND A.I. : Inventorship

Although there is no explicit definition of inventorship in the European Patent Convention (EPC), the common understanding is that inventors need to be <u>natural persons.</u>

According the approach for standard inventions, the simple «owner», who has not contributed to the invention, cannot be the inventor.

The <u>designer is the inventor</u> if has given an essential contribute to the problem identification and its solution while user involvement has been limited to switching on the system and/or reading the results.

Otherwise, the <u>user can be the inventor</u> if he/her has given an essential contribute to the result and the NN designer has provided only general knowledge on NN.

*By **Andres Guadamuz**, Senior Lecturer in Intellectual Property Law, University of Sussex, United Kingdom*

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Grazie !

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Consulenza in Proprietà Industriale e Intellettuale

Ing. Ferruccio Postiglione
Senior Partner
Italian and European Patent Attorney

PRAXI INTELLECTUAL PROPERTY S.p.A.
20145 Milano - Via Mario Pagano, 69/A
T +39 02 4980733 - **F** + 39 02 48003813
ferruccio.postiglione@praxi-ip.praxi - www.praxi-ip.praxi
Genova - Milano - Padova - Roma - Torino - Trento - Verona