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— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *of inventorship (Rule 4.17(iv))*

[Continued on next page]

(54) **Title**: A THIN-CLIENT BASED ARCHITECTURE FOR ENGINEERING WORKPLACE IN AUTOMATION SYSTEM

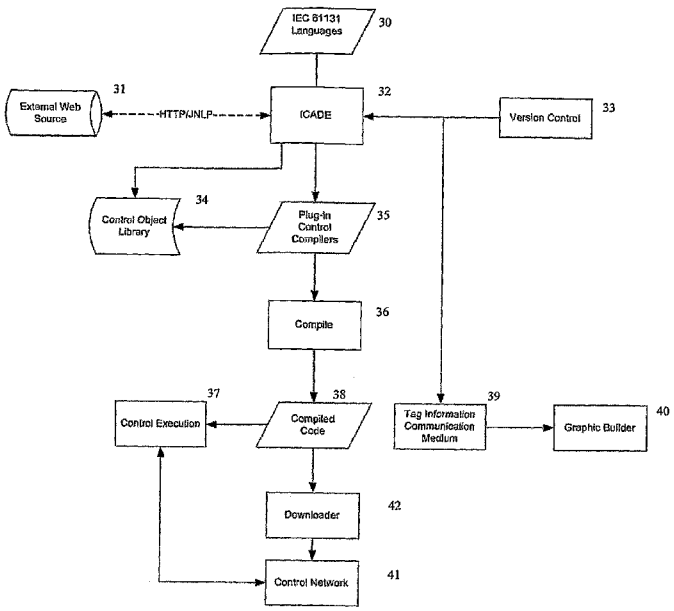


Figure 5.

(57) **Abstract**: The present invention proposes a thin-client based integrated control application development environment (ICADE) for developing control applications for users that are building automation applications. The platform-independent system allows users to cinfigure control networks and devices, program, test, monitor, debug and troubleshoot control applications that are ultimately downloaded on one or more control engines in an automation control network. The ICADE-system (32) includes an engineering workplace thin-client and an engineering workplace server which include control application programming languages (30), an editor, control objects (34), plug-in compilers (35), version control (33), external web sources (31), a downloader (42), a control execution component (37) and an OPC component (39).

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A THIN-CLIENT BASED ARCHITECTURE FOR ENGINEERING WORKPLACE IN AUTOMATION SYSTEMS

FIELD OF THE INVENTION

A platform-independent Thin-Client based architecture for Engineering Workplace to provide engineering access for Engineers via any standard web-browser.

DISCUSSION OF PRIOR ART

Thin-client technology allows the client software to be downloaded from a remote server and executed locally on the client machine. The download of platform-independent Thin-Client can be performed by a standard web-browser, which upon download can invoke the services of a local run-time engine to execute the Thin-Client. Examples of Thin-Client technologies are Java and .Net. In the case the Java technology, the Thin-Client would be an Applet or a Web-start Application, which are recognized by standard MIME-types by all standard web-browsers, and the run-time would be a Java Runtime Environment (JRE). The advantage of Thin-Client technology is zero application-installation requirements on the client machine, universal application accessibility across networks, platform independence, centralized deployment, and many others.

US2005197157 summarizes application development in quasi-Thin-Client or mobile environments that are not specific to automation, which use markup languages, as opposed to procedural languages. **US20040121299A1** alludes to an on-line collaboration system that could be extrapolated to programming environments, which further proposes the interaction of Thin-Clients and present ideas about data-maintenance and session co-ordination.. Further an arbitrator of some sort has to be present (at some stage of deploying this as a full-blown product) to enable distributed programming **US6405246B1** wherein an Object Adaptor **11** is responsible for determining which objects are required and supplying these *on demand.* Tiered architectures

WO/2001/033349 have been proposed to modularize the various components that interact to provide an application development and further an application execution environment without an emphasis on Thin-Clients. Resource constrained clients alongside an application-development component have been proposed **WO/2003/017094** but, these are again not specific to automation. The MCB wireless system has an application component for building Thin-Client, wireless applications where resource constrained clients are taken into account and emphasis is placed on server-centric programming with Thin-Client feel, though this is not specific to automation.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a thin-client based, Integrated Control Application Development Environment (ICADE) for industrial control systems, using languages such as the IEC61131 suite. It is another object of this invention to provide a centralized automation application development environment that enables several users to develop automation applications, simultaneously, by accessing a central facility. It is another object of this invention to provide a platform-independent engineering workplace architecture that is executable on various operating environments. It is another object of this invention to enable a user to switch between on-line and off-line mode of automation application development thereby catering to occasional network disruptions or intermittent connectivity. The architecture of the present invention does not require the Thin-Client to be dependent on the central facility for all its operations. Therefore, the user can switch between on-line and off-line modes after the Thin-Client is loaded on the client machine when network disruptions are felt by the user. User initiated switching between on-line and off-line mode of working for the Thin-Client ensures maximum operational flexibility and seamless workflow in the development environment.

The Engineering Workplace provides the following functionality to the end-user

1. **Control Network configuration,** wherein the end-user can configure the computers and controllers on the Control Network using the Thin-Client Engineering Workplace.

2. **Device configuration**, wherein the end-user can further configure various devices on the Field IO network, or the plant network using the Thin-Client Engineering Workplace.

3. **Automation-application development**, wherein the Engineering Workplace provides an IDE (Integrated Development Environment) for the end-user to program, compile, and debug control applications, using IEC 61131 languages, using the services provided by the central facility.

4. **Automation-application deployment**, wherein the Engineering Workplace provides mechanisms for the end-user to download the developed control applications onto various control engines on the Control Network.

5. **Automation-application troubleshooting** wherein the IDE provided by the Engineering Workplace additionally provides mechanisms for the end-user to monitor, debug, and troubleshoot control applications downloaded onto various control engines on the Control Network.

6. **Automation-application maintenance**, wherein the Engineering Workplace provides maintenance UI for the end-user to perform control system administration activities such as version control of downloaded applications, change management, etc.

The thin-client based ICADE of the present invention can be downloaded from a server, on-demand and used by multiple users separated across a network. Further the ICADE can provide a unified User-Interface for developing Control Applications for multiple industrial controllers, which usually have a multitude of Control Object Libraries.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 depicts the communication pattern for a Centralized Architecture for the Engineering Workplace.

Fig. 2 depicts the communication patterns in a Decentralized Architecture for the Engineering Workplace.

Fig. 3 depicts a two-tier network configuration.

Fig. 4 depicts a single-tier network configuration.

Fig. 5 shows a simplified flow chart depicting relationship and data flow between various subsystems in the Engineering Workplace.

Fig. 6 depicts a controller-centric architecture.

Fig. 7 depicts a Thin-Client centric architecture.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 depicts the communication pattern for a Centralized Architecture for the Engineering Workplace. The Thin-Client Engineering Workplace **1** communicates with the Engineering Workplace Server **2** in order to provide the users with a seamless application development environment. The Engineering Workplace Server **2** shall, in turn, communicate with the Control Engines on various Controllers **3, 4, 5** to realize Controller-specific operations. The communications between the Engineering Workplace Server **2** and the Controllers **3, 4, 5** can occur over Ethernet using proprietary or any standard suite of protocols. The communications between the Thin-Client Engineering Workplace **1** and the Engineering Workplace Server **2** may occur over Ethernet using HTTP-based or any other proprietary protocol based or any other standards-based suite of messaging protocols.

Fig. 2 depicts the communication patterns in a Decentralized Architecture for the Engineering Workplace. The difference between the Centralized Architecture and the Decentralized Architecture is that the Engineering-Workplace Thin-client **6** can now communicate directly with the Control Engines on various controllers **7, 8, 9** over Ethernet using proprietary or any standard suite of protocols. A major advantage of the Decentralized Architecture over the Centralized Architecture is the reduced dependency of the Engineering-Workplace Thin-Client **6** on the Engineering-Workplace Server **10.**

The disadvantage of the Decentralized Architecture is the increased code-size as well as complexity of the Engineering-Workplace Thin-Client, which would result in slower download and start-up durations.

Two modes of network configuration can be envisioned as shown in Fig. 3 and Fig. 4. Fig. 3 depicts a two-tier network configuration, which is aimed at separating the network traffic due to the communications between the Engineering-Workplace Server **11** and Engineering-Workplace Thin-client **12,** which interact with the plant network **13** and that due to the Engineering-Workplace Server **11** and the Controllers **15, 16, 17,** which interact with the control network **14.** Fig. 4 depicts a single-tier network configuration that does not provide such a separation. In this setup, the control network **20** in the focal point of all communications between the various entities such as the Engineering Workplace Server **21,** the Thin-Client Engineering Workplace **22** and the controllers **23, 24, 25** The Centralized Architecture can be used with both the configurations while the Decentralized Architecture can be used with the single-tier network configuration. Table 1 summarizes the relationship between the configurations and the architectures.

	2-tier n/w conf	1-tier n/w conf
Centralized Architecture	Yes	Yes
Decentralized Architecture	No	Yes

Table 1 Modes of configuration for each architecture

Fig. 5 shows a simplified flow chart depicting relationship and data flow between various subsystems in the Engineering Workplace. The Engineering Workplace provides an IDE to develop control applications using any of the IEC 61131 Language **30** construct, complete with an Integrated Control and Development Environment (ICADE) **32** and version control means **33** for the end-user to program. The user further has the option of using external web sources **31** enabled by such communication and network protocols as HTTP/JNLP. Control object library **34** are generated with the use of plug-in control compilers **35** to compile **36** programs, and debug control applications. Upon compilation, compiled code **38** is generated, that is used for control execution **37** after being

downloaded by a downloader **42** over the control network **41.** The present invention further lends itself to the use of a tag information communication medium **39** to expose variables to other applications such as the graphics builder **40.** The Graphics Builder **40** is used to create graphical interfaces, including animation, for controlling industrial processes using various Graphic Elements. The output of the Graphics Builder is an animation graphics, which can be in formats such as SVG, Macromedia Flash, XAML, etc. The Integrated Control and Development Environment (ICADE) **32** can be provided with target specific compilers **35** as a plug-in. The Integrated Control and Development Environment (ICADE) **32** provides mechanisms to develop control applications using suitable control application development languages like IEC 61131 language **30** including instruction list, structured text, function block diagram, ladder diagram, and sequential function chart. Target specific compilers **35** can be plugged into the Integrated Control and Development Environment (ICADE) **32** for compiling the program code to object code **38** depending on the controller to which the Control Object library **34** will be downloaded. Control Object library **34** represent one or more control variables managed by an industrial controller. Control Objects maybe stored in proprietary or standardized formats such as XML, Oracle DB elements, etc.

Fig. 6 shows the controller-centric architecture wherein the thin client based engineering workplace **45** contains the Integrated Control and Development Environment (ICADE) **47**, which allows programming using any of the IEC 61131 languages **48.** This thin client based engineering workplace **45** is demarcated from the engineering workplace server **46,** which contains the plug-in control compilers **49** which assist in the generation of control object library **50.** Version control **51** is performed in the engineering workplace server **46.** The programs are compiled **52** generating compiled code **53.** Web sources **54** are now a part of the engineering workplace server **46** and interact with the Integrated Control and Development Environment (ICADE) **47** residing in the thin based engineering workplace **45** block, via communication protocols such as HTTP, JNLP etc. The compiled code **53** can be downloaded onto the control network **57** after going through control execution **55,** which is a process providing the ability to run control programs in Test mode (as a simulation) and run in online mode (as a debugging tool). Alternatively, a downloader **56**

can be used to download the compiled code **53** onto the control network. The engineering workplace server **46**, further enables the exposition of declared variables to the graphics builder **59** by means of an Tag information medium **58.**

Fig. 7 depicts a Thin-Client centric architecture wherein more functionality is moved into the thin client based engineering workplace **60** and less functionality is maintained by the engineering workplace server **61.** The thin client based engineering workplace **60** contains the Integrated Control and Development Environment (ICADE) **62**, which allows programming using any of the IEC 61131 languages **63.** The plug-in control compilers **64** are also housed in the thin client based engineering workplace **60** wherein the programs are compiled **65** generating compiled code **66.** The compiled code **66** can be downloaded onto the control network **69** after going through control execution **67,** or with via a downloader **68.**

This thin client based engineering workplace **60** is demarcated from the engineering workplace server **61**, which contains means for version control **70.** Web sources **71** residing in the thin based engineering workplace, interact with the Integrated Control and Development Environment (ICADE) **62**, via communication protocols such as HTTP, JNLP etc. In the Thin-Client centric architecture, control object library **72** maintained in the engineering workplace server **61**, which further enables the exposition of declared variables to the graphics builder **73** by means of a tag information communication medium component **74.**

CLAIMS

1. A system for enabling Thin-Client based Integrated Control Application Development Environment (ICADE), alternatively called the Thin-Client Engineering Workplace, for developing control applications for industrial controllers, controlling devices on the control network and one or more field devices, comprising:
    a. Means for collaboratively developing, debugging, troubleshooting, and deploying control applications for automation systems using proprietary and standard languages like those specified in IEC 61131;
    b. Means for deploying applications, for automation domains wherein the users can collaboratively download the developed applications onto various control engines;
    c. Means for downloading the ICADE on-demand by one or more authorized users, connected on the network, said authorized users utilizing generic thick-clients like web-browsers;

2. A system of claim 1 with means for developing applications for automation domains such that the end-user can program, compile and debug control applications, using the services of the system, which could be both centralized and de-centralized;

3. A system of claim 1 with means for debugging, troubleshooting and maintaining applications developed assisting the end-user to monitor the control applications and further perform control system administration activities, such as version control of downloaded applications, manage changes etc.

4. A system of claim 1 with additional means to perform configuration of both control network and devices in an automation domain;
5. A system of claim 1 with additional means for exposing variables declared for building said automation applications to other applications such as Graphics

Builders, by suitable means like HTTP, OPC, file transfer, and other communications; and

6. A system of claim 1 wherein the system can be either:
    a. Centralized, wherein a Plant Network interconnects the Engineering Workplace Thin-Client and Engineering Workplace Server while one or more Control Networks interconnet the Engineering Workplace Server and various Controllers; and
    b. De-centralized, wherein a Control Network interconnects the Engineering Workplace Thin-Client, Engineering Workplace Server, and various Controllers.

7. A system of claim 1, wherein only authorized users can download the said ICADE using known appropriate authentication and authorization techniques.

8. A system of claim 1, wherein the network connecting various entities can be either:
    a. Single-Tier, wherein any Engineering Workplace Thin-Client can directly communication with various Controllers;
    b. Two-tiered, wherein all Engineering Workplace Thin-Clients can interact only with one or more Engineering Workplace Servers before effecting changes on various Controllers.

9. A system of claim 1, wherein the system can be implemented using any standard programming technology such as Sun Microsystem's JAVA, Microsoft ActiveX, C++, Microsoft C# and .NET, JavaScript, AJAX, etc.

10. A system of claim 1, wherein the system can be implemented using any proprietary programming technology.

11. A system of claim 1, wherein any communication protocol like SOAP, HTTP, TCP, Telnet, Web Services, OPC etc. may be used for communications between the Engineering Workplace Thin-Client and any other component of the ICADE system.

12. A system of claim 1, wherein the Engineering Workplace Thin-Client and the Engineering Workplace Server include:

a. A set of control application programming languages that can be proprietary or standardized such as the languages specified in IEC 61131;
b. An editor, which is used to develop control applications;
c. Control objects, which represent one or more control variables, managed by an industrial controller and stored in proprietary or standardized formats such as XML, RDBMS records, and so on;
d. Plug-in compilers, which compile control applications described in suitable languages to controller-specific object code that can be downloaded to a controller for subsequent control application execution;
e. Means to provide version control for one or more versions control application descriptions;
f. One or more external web sources communicating with the Engineering Workpalce Thin-Client by means of communication protocols such as HTTP, JNLP, and so on;
g. A downloader process for downloading the object code onto various controllers;
h. A Control Execution Component, which provides the ability to locally execute control applications for debugging purposes and to remotely execute control applications on various controllers and monitor the execution for trouble-shooting purposes.
i. An OPC component to expose the variables of the control applications to one or more applications, such as Graphics Builders; and

13. A system of claim 1 wherein the programs can be written using a plurality of laguages specified in IEC-61131 such as instruction list, structured text, ladder logic, function block diagram, and sequential function chart.

14. A system of claim 1, wherein a Server-centric architecture comprises:
    a. A Engineering Workplace Thin-Client that houses the editor used to develop control applications and control objects by describing control applications using suitable languages such as those specified in IEC 61131; and
    b. An Engineering Workplace Server that houses control applications descriptions, control objects, plug-in control compilers, version control means, control execution processes, external web sources, downloaders, control application object code, and communication components to interact with external applications such as graphics builders, wherein the control application object code is transferred to the control networks via the downloaders or after passing through control execution.

15. A system of claim 1, wherein a Thin-Client-Centric architecture comprises:
    a. A Engineering Workplace Thin-Client that houses the editor used to develop control applications and control objects by describing control applications using suitable languages such as those specified in IEC 61141, plug-in control compilers, control application descriptions, control execution processes, downloaders and control application object code wherein the object code is transferred to the control networks via the downloaders or after passing through control execution; and
    b. An Engineering Workplace Server that houses control applications object code, control objects, version control means, external web sources, and communcation components to interact with external applications such as graphics builders.

16. A system of claim 1, wherein the ICADE can be implemented and used on a plurality of platforms including personal computers, dumb-terminals, tablet PCs etc.

17. A system of claim 1, where in the ICADE may be platform dependent or platform independent;

18. A method for downloading an Engineering Workplace Thin-Client for interacting with an Engineering Workplace Server for developing control applications for one or more controllers using proprieatary or standardized control application development languages, like those specified in IEC 61131, by one or more authorized users in a collaborative manner, wherein the said Engineering Workplace Thin-Client and said Engineering Workplace Server are parts of an Integrated Control Application Development Environment (ICADE).

19. The method of Claim 18, comprising the steps of;
    a. downloading the said Engineering Workplace Thick-Client using a standard Thick-Client application, like web browser using the said Engineering Workplace Server;
    b. Executing the said Engineering Workplace Thin-Client on the thick-client application;
    c. Developing control applications for various controllers using proprietary or standardized control application development languages such as those specified in IEC 61131, by using the thin-client application.
    d. developing, debugging, deploying, and troubleshooting control applications for and on various controllers that ultimately execute the control applications by using the said ICADE

20. The method of Claim 18, wherein the said ICADE provide version control facilities for precisely determining and changing over to appropriate versions of control applications;

a. The said ICADE provides access to one or more authorized users for the Engineering Workplace Thin-Client;
b. The said ICADE allows one or more users to collaboratively develop control applications.

21. The method of claim 19, wherein only authorized users can download the said ICADE using known appropriate authentication and authorization techniques

22. The method of Claim 18, where in the method can be either:
a. Centralized, wherein a Plant Network interconnects the Engineering Workplace Thin-Client and Engineering Workplace Server while one or more Control Networks interconnect the Engineering Workplace Server and various Controllers; and
b. De-centralized, wherein a Control Network interconnects the Engineering Workplace Thin-Client, Engineering Workplace Server, and various Controllers.

23. The method of claim 18, wherein the network connecting various entities can be either:
a. Single-Tier, wherein any Engineering Workplace Thin-Client can directly communication with various Controllers;
b. Two-tiered, wherein all Engineering Workplace Thin-Clients can interact only with one or more Engineering Workplace Servers before effecting changes on various Controllers.

24. The method of claim 18, wherein any communication protocol like SOAP, HTTP, TCP, Telnet, Web Services, OPC etc. may be used for communications between the Engineering Workplace Thin-Client and any other component of the ICADE system.

25. The method of claim 18, wherein the Engineering Workplace Thin-Client and the Engineering Workplace Server include:

a. A set of control application programming languages that can be proprietary or standardized such as the languages specified in IEC 61131;

b. An editor, which is used to develop control applications;

c. Control objects, which represent one or more control variables, managed by an industrial controller and stored in proprietary or standardized formats such as XML, RDBMS records, and so on;

d. Plug-in compilers, which compile control applications described in suitable languages to controller-specific object code that can be downloaded to a controller for subsequent control application execution;

e. Means to provide version control for one or more versions control application descriptions;

f. One or more external web sources communicating with the Engineering Workpalce Thin-Client by means of communication protocols such as HTTP, JNLP, and so on;

g. A downloader process for downloading the object code onto various controllers;

h. A Control Execution Component, which provides the ability to locally execute control applications for debugging purposes and to remotely execute control applications on various controllers and monitor the execution for trouble-shooting purposes.

i. An OPC component to expose the variables of the control applications to one or more applications, such as Graphics Builders; and

26. The method of claim 18, wherein the programs can be written using a plurality of languages specified in IEC-61131 such as instruction list, structured text, ladder logic, function block diagram, and sequential function chart.

27. The method of claim 18, wherein a Server-centric architecture comprises:

a. A Engineering Workplace Thin-Client that houses the editor used to develop control applications and control objects by describing control applications using suitable languages such as those specified in IEC 61131; and

b. An Engineering Workplace Server that houses control applications descriptions, control objects, plug-in control compilers, version control means, control execution processes, external web sources, downloaders, control application object code, and communication components to interact with external applications such as graphics builders, wherein the control application object code is transferred to the control networks via the downloaders or after passing through control execution.

28. The method of claim 18, wherein a Thin-Client-Centric architecture comprises:

a. A Engineering Workplace Thin-Client that houses the editor used to develop control applications and control objects by describing control applications using suitable languages such as those specified in IEC 61141, plug-in control compilers, control application descriptions, control execution processes, downloaders and control application object code wherein the object code is transferred to the control networks via the downloaders or after passing through control execution; and

b. An Engineering Workplace Server that houses control applications object code, control objects, version control means, external web sources, and communication components to interact with external applications such as graphics builders.

29. The method of claim 18, wherein the ICADE can be implemented and used on a plurality of platforms including personal computers, dumb-terminals, tablet PCs etc.

30. A method of claim 18, where in the ICADE may be platform dependent or platform independent;

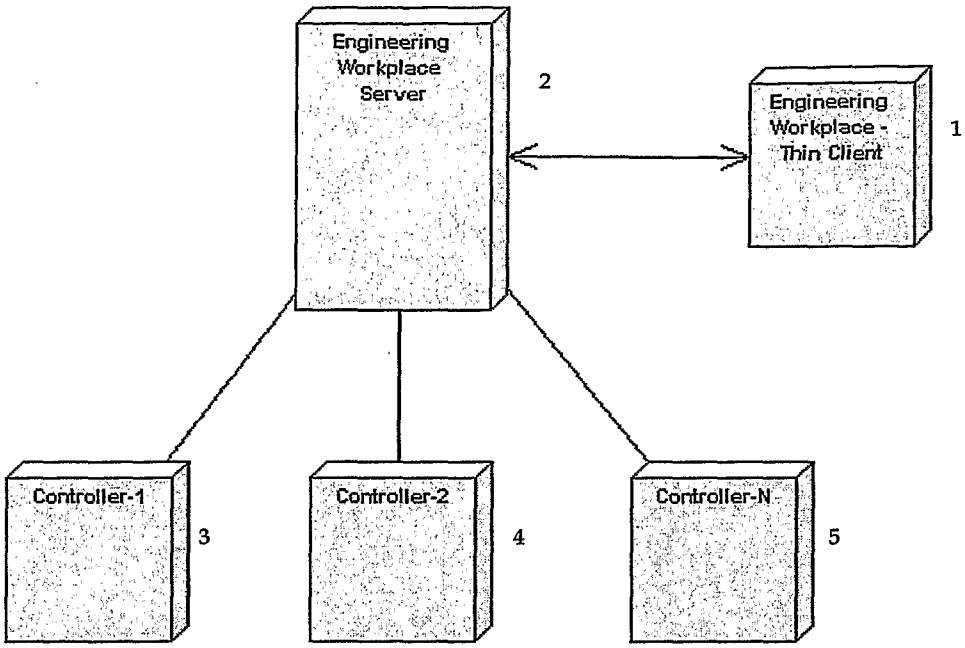


FIGURE-1

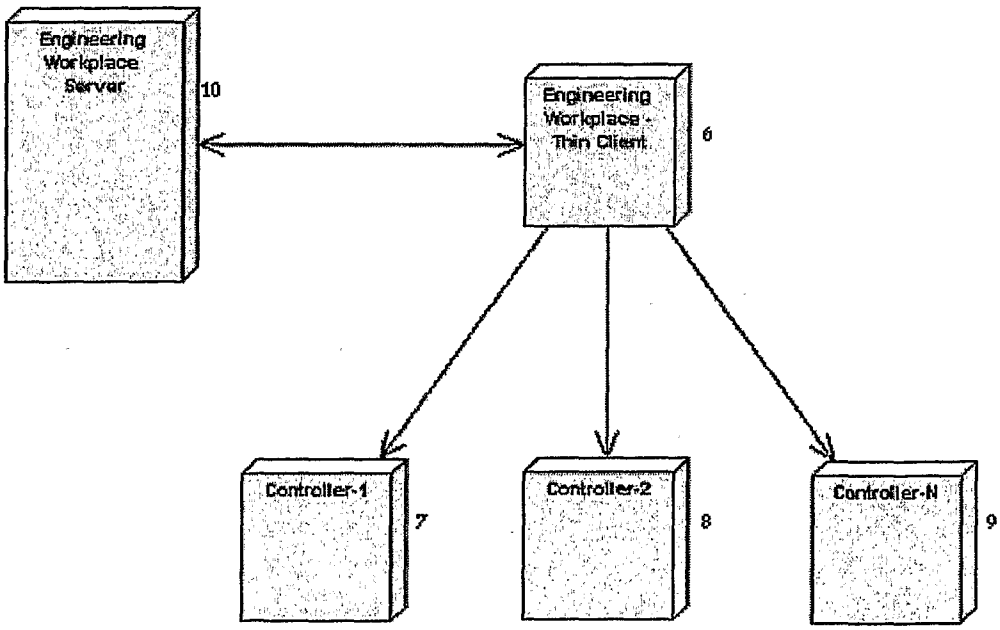


FIGURE-2

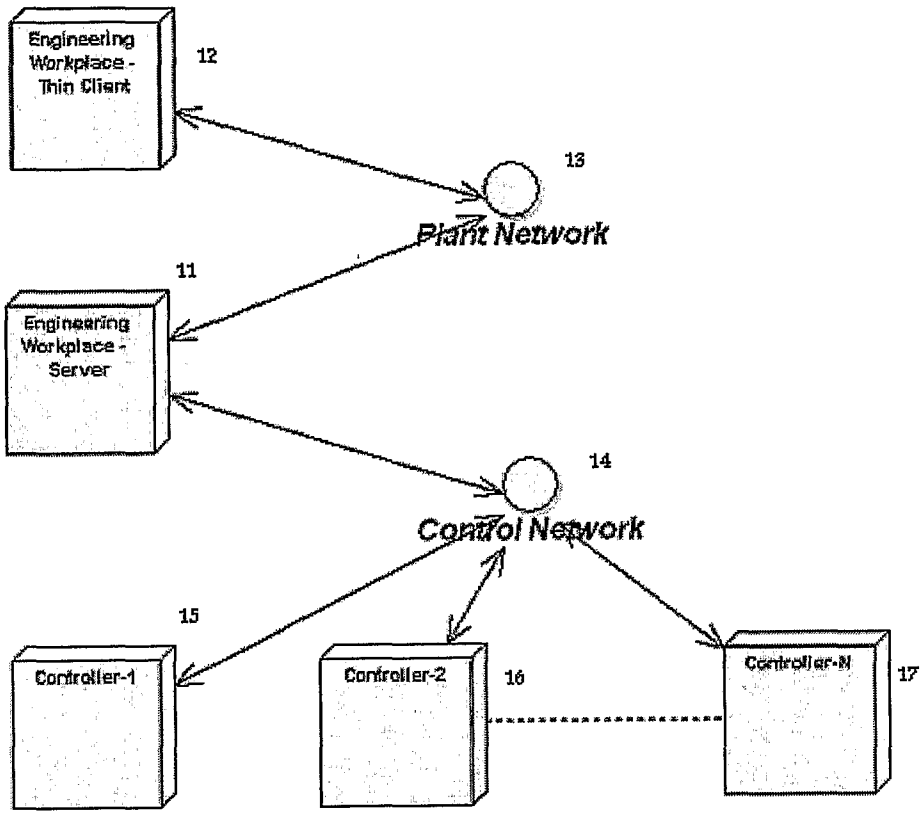

Engineering Workplace - Thin Client
12
13
Plant Network
11
Engineering Workplace - Server
14
Control Network
15
Controller-1
Controller-2
16
Controller-N
17

FIGURE:3

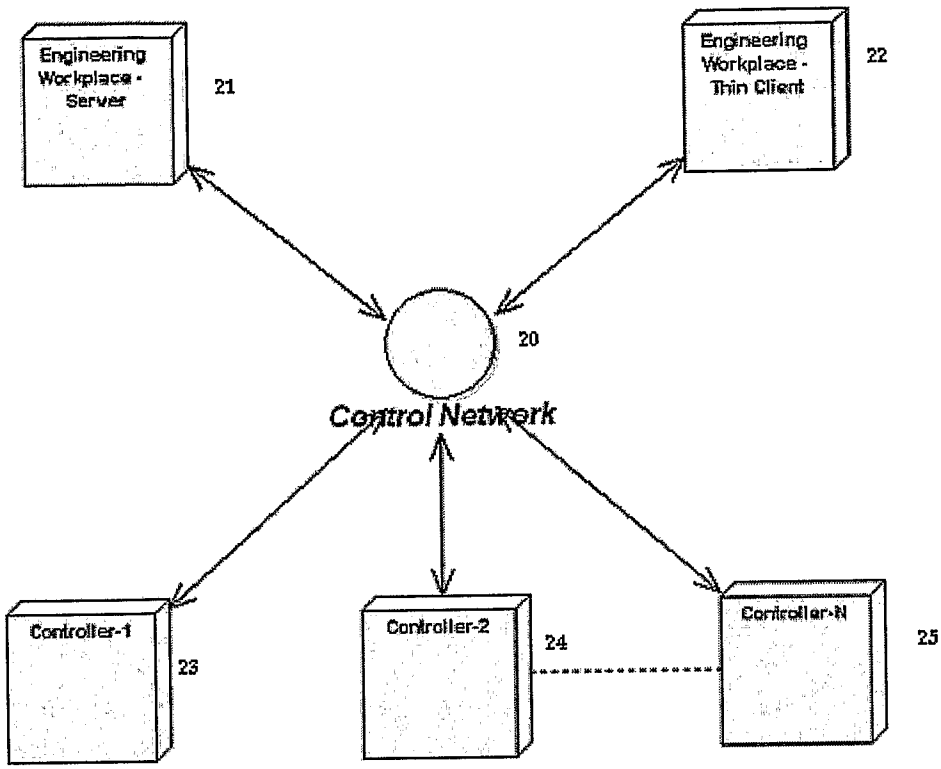

Engineering Workplace - Server
21
Engineering Workplace - Thin Client
22
20
Control Network
Controller-1
23
Controller-2
24
Controller-N
25

FIGURE: 4

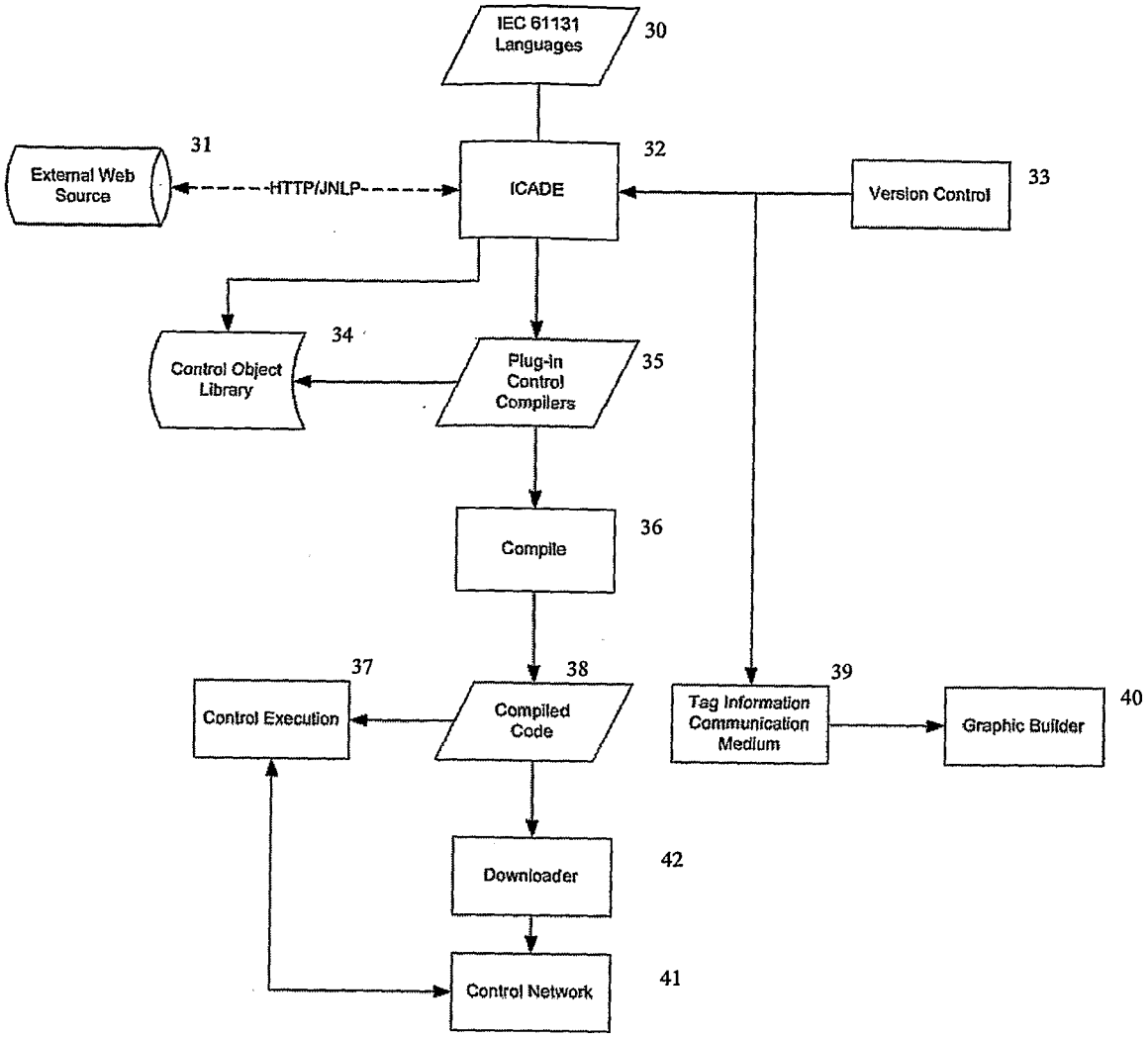

IEC 61131 Languages
30
External Web Source
31
HTTP/JNLP
ICADE
32
Version Control
33
Control Object Library
34
Plug-in Control Compilers
35
Compile
36
Control Execution
37
Compiled Code
38
Tag Information Communication Medium
39
Graphic Builder
40
Downloader
42
Control Network
41

Figure 5.

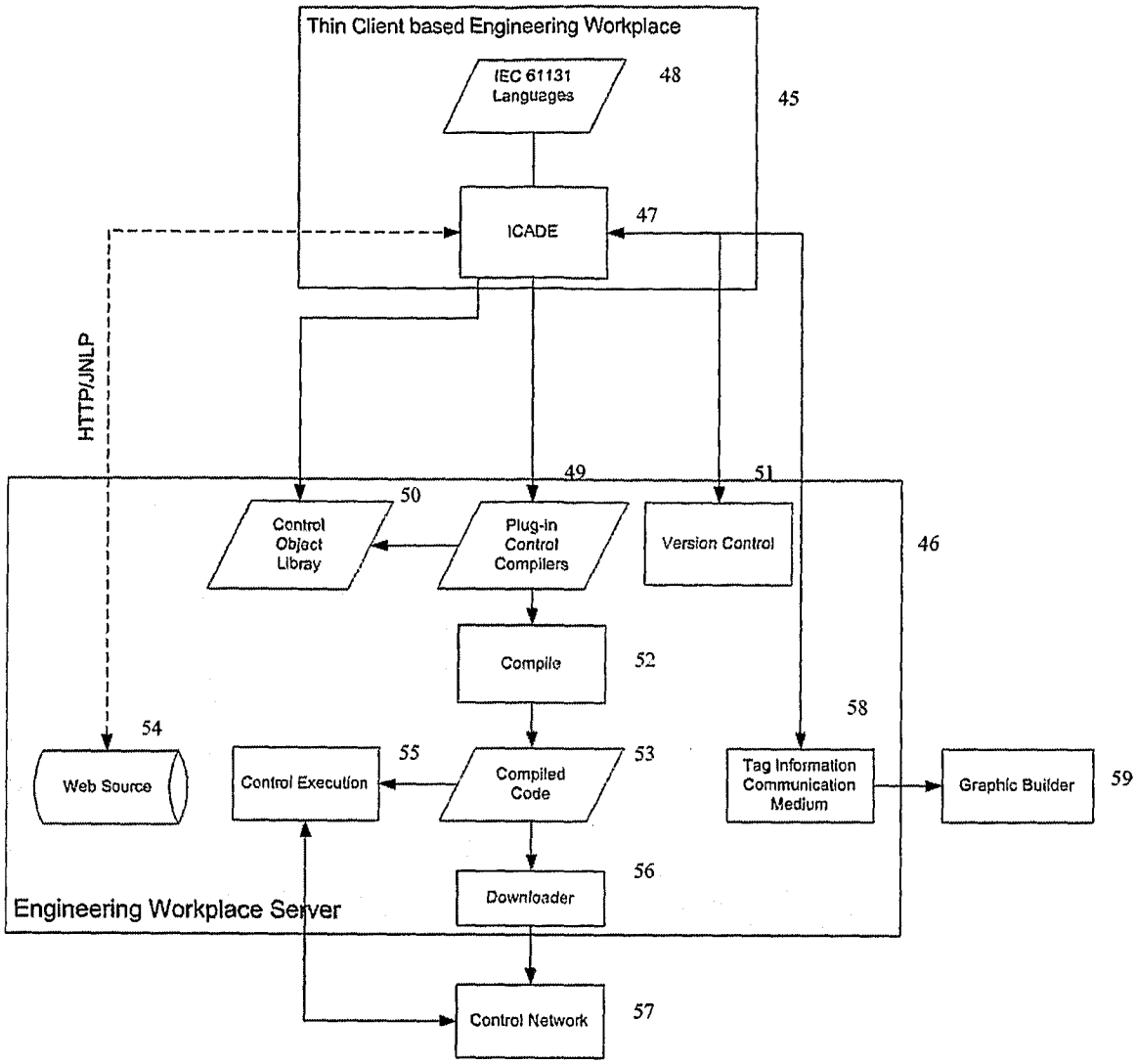

Thin Client based Engineering Workplace
IEC 61131 Languages
48
45
ICADE
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HTTP/JNLP
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50
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52
58
54
Web Source
55
Control Execution
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53
Tag Information Communication Medium
Graphic Builder
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56
Downloader
Engineering Workplace Server
Control Network
57

Figure 6.

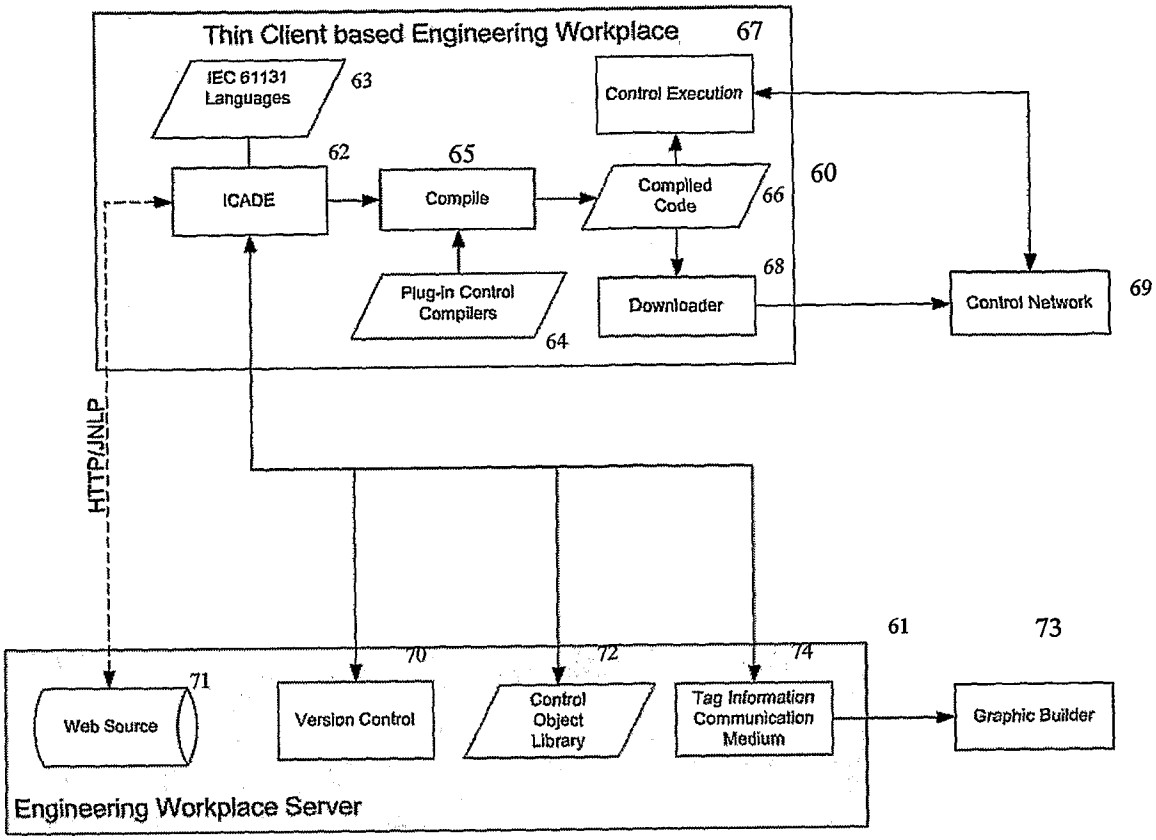

Thin Client based Engineering Workplace
67
IEC 61131 Languages
63
Control Execution
62
65
ICADE
Compile
Compiled Code
66
60
Plug-in Control Compilers
64
68
Downloader
Control Network
69
HTTP/JNLP
61
73
70
72
74
71
Web Source
Version Control
Control Object Library
Tag Information Communication Medium
Graphic Builder
Engineering Workplace Server

Figure 7.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 2008/000360

A. CLASSIFICATION OF SUBJECT MATTER
IPC[8]: ***G05B 19/418*** (2006.01); ***G06F 9/45*** (2006.01); ***H04L 12/26*** (2006.01)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC[8]: G05B, G06F, H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPODOC, WPI, TXTDE, TXTEN

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 284 446 A1 (ROCKWELL SOFTWARE INC.) 19 February 2003 (19.02.2003) *Abstract; Figures 1-4, 9; Description of Figures; Claims 1-11, 13-22;* --	1-30
X	US 2003/061311 A1 (LO) 27 March 2003 (27.03.2003) *Abstract; Figures 3-4, 6, 11-12, 14-15, 17; Description of Figures; Claims 11-16;* --	1-30
X	DE 100 53 665 A1 (WWL INTERNET AG) 2 May 2002 (02.05.2002) *Abstract; Figure; Description of Figure; Claims 1-6, 8, 12;*	1-11, 13-14, 16-24, 26-30
A	--	12,15, 25

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 October 2008 (02.10.2008)	15 October 2008 (15.10.2008)
Name and mailing address of the ISA/ AT **Austrian Patent Office** Dresdner Straße 87, A-1200 Vienna Facsimile No. +43 / 1 / 534 24 / 535	Authorized officer STOLL J. Telephone No. +43 / 1 / 534 24 / 550

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A		7, 12, 21, 25
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X	DE 102 29 923 A1 (LANGMANN REINHARD) 29 January 2004 (29.01.2004) *Abstract; Figures 1-5; Description of Figures; Claims 1-5, 7-8;*	1-6, 8-11, 13-20, 22-24, 26-30
A		7, 12, 21, 25
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X,E	EP 1 906 592 A1 (ROCKWELL AUTOMATION TECHNOLOGIES, INC.) 2 April 2008 (02.04.2008) *Abstract; Figures 1-3, 12-13, 15; Description of Figures; Claims 1-2, 5, 7-12, 15, 17-21;*	1-6, 8-11, 16-20, 22-24, 29-30
A		7, 12-15, 21, 25-28

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Information on patent family members

International application No.
PCT/IB 2008/000360

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