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[Continued on next page]

(54) **Title:** POPULATION-BASED LEARNING WITH DEEP BELIEF NETWORKS

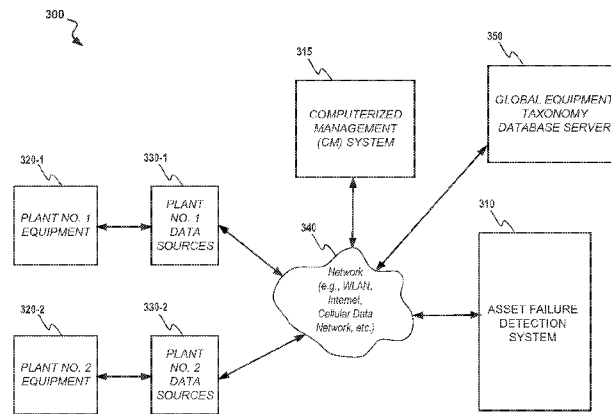
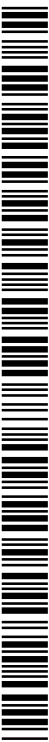


FIG. 3

(57) **Abstract:** A plant asset failure prediction system and associated method. The method includes receiving user input identifying a first target set of equipment including a first plurality of units of equipment. A set of time series waveforms from sensors associated with the first plurality of units of equipment are received, the time series waveforms including sensor data values. A processor is configured to process the time series waveforms to generate a plurality of derived inputs wherein the derived inputs and the sensor data values collectively comprise sensor data. The method further includes determining whether a first machine learning agent may be configured to discriminate between first normal baseline data for the first target set of equipment and first failure signature information for the first target set of equipment. The first normal baseline data of the first target set of equipment may be derived from a first portion of the sensor data associated with operation of the first plurality of units of equipment in a first normal mode and the first failure signature information may be derived from a second portion of the sensor data associated with operation of the first plurality of units of equipment in a first failure mode. Monitored sensor signals produced by the one or more monitoring sensors are received. The first machine learning agent is then and activated, based upon the determining, to monitor data included within the monitored sensor signals.



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**A. CLASSIFICATION OF SUBJECT MATTER****G05B 23/02(2006.01)i**

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)  
G05B 23/02; G06F 11/07; G01D 18/00; G01R 31/00; G06F 3/00Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
Korean utility models and applications for utility models  
Japanese utility models and applications for utility modelsElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
eKOMPASS(KIPO internal) & Keywords: plant, failure, signature, sensor, monitor**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2008-0271057 A1 (ALEX BATES et al.) 30 October 2008 See paragraphs [0025]-[0047], claim 1 and figures 1, 2.	1-15
A	US 2013-0191681 A1 (ALEXANDER ALEXANDROVICH MOISEEV et al.) 25 July 2013 See paragraphs [0044]-[0048], claim 1 and figure 2.	1-15
A	JP 2013-058222 A (ROSEMOUNT INC.) 28 March 2013 See paragraphs [0013]-[0035], claim 1 and figure 1.	1-15
A	US 2013-0226492 A1 (ALEXANDER ALEXANDROVICH MOISEEV et al.) 29 August 2013 See paragraphs [0069]-[0071], claim 1 and figure 6.	1-15
A	US 2014-0088893 A1 (ROSEMOUNT INC.) 27 March 2014 See paragraphs [0022]-[0036], claim 1 and figure 2a.	1-15

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

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Information on patent family members

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US 2008-0271057 A1	30/10/2008	US 8380842 B2 US 9141096 B1	19/02/2013 22/09/2015
US 2013-0191681 A1	25/07/2013	CN 103140812 A EP 2628058 A1 JP 2013-539885 A WO 2012-050475 A1	05/06/2013 21/08/2013 28/10/2013 19/04/2012
JP 2013-058222 A	28/03/2013	CN 101273314 A CN 101273314 B EP 1932068 A1 JP 2009-510600 A JP 2015-172968 A US 2006-0241907 A1 WO 2007-040776 A1	24/09/2008 04/07/2012 18/06/2008 12/03/2009 01/10/2015 26/10/2006 12/04/2007
US 2013-0226492 A1	29/08/2013	CN 103140811 A EP 2628059 A1 JP 2013-539886 A WO 2012-050477 A1	05/06/2013 21/08/2013 28/10/2013 19/04/2012
US 2014-0088893 A1	27/03/2014	CN 103698622 A CN 203772970 U WO 2015-034559 A1	02/04/2014 13/08/2014 12/03/2015