US 20100238462A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2010/0238462 A1

(43) Pub. Date: Sep. 23, 2010

Reitz et al.

(54) SYSTEM AND METHOD FOR IMAGE QUALITY ANALYSIS AND DIAGNOSTICS

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(21) Appl. No.: **12/405,782**

(22) Filed: **Mar. 17, 2009**

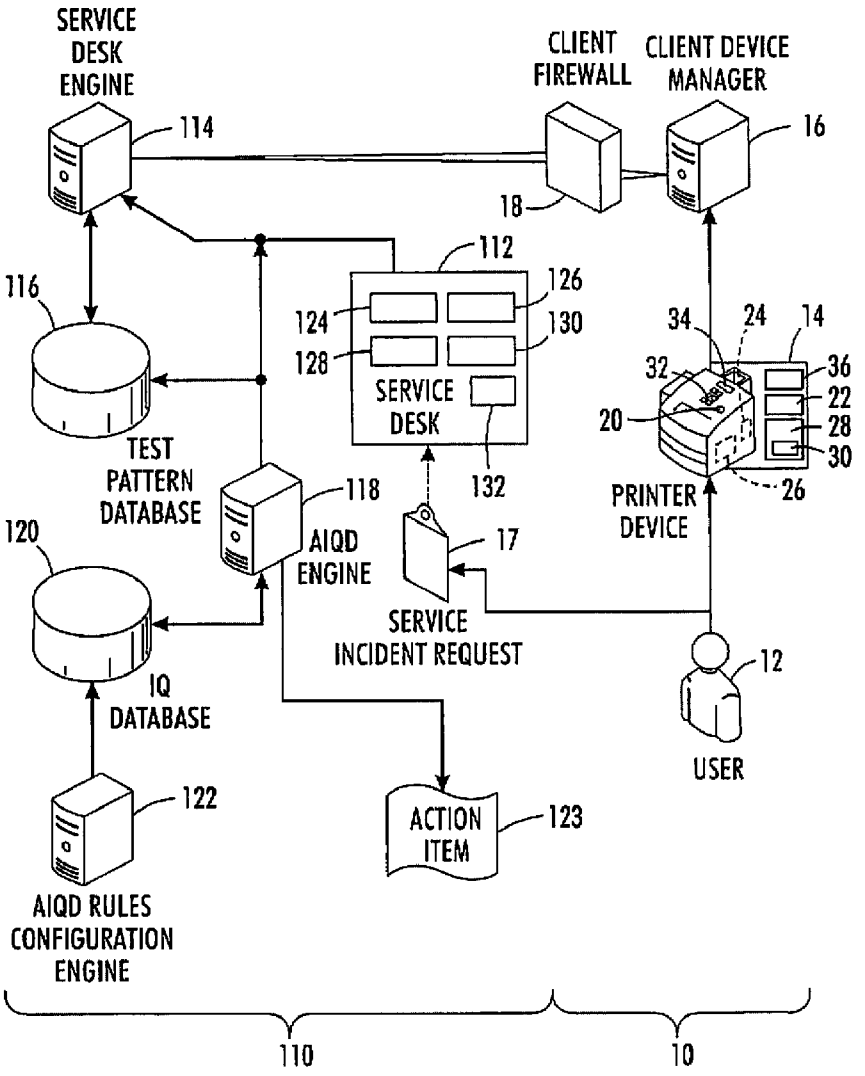
Publication Classification

(51) **Int. Cl.**
H04N 1/60 (2006.01)
G06F 3/12 (2006.01)

(52) **U.S. Cl.** **358/1.9**; 358/1.15

(57) **ABSTRACT**

A system and method for diagnosing image quality of a printer device's output is provided. The method includes receiving by a processor, via a network from a remote node of the network, a service incident report. The incident report includes an indication of a type of the printer device the printer device being disposed along the network at a location remote from the processor. The method further includes accessing by the processor a storage device storing a collection of test patterns, selecting by the processor a test pattern from the collection of test patterns based on the type of the printer device, wherein the test pattern is configured as input that the printer device can receive and output corresponding printed output, and transmitting by the processor the selected test pattern for the selected test pattern to be provided as input to the printer device.



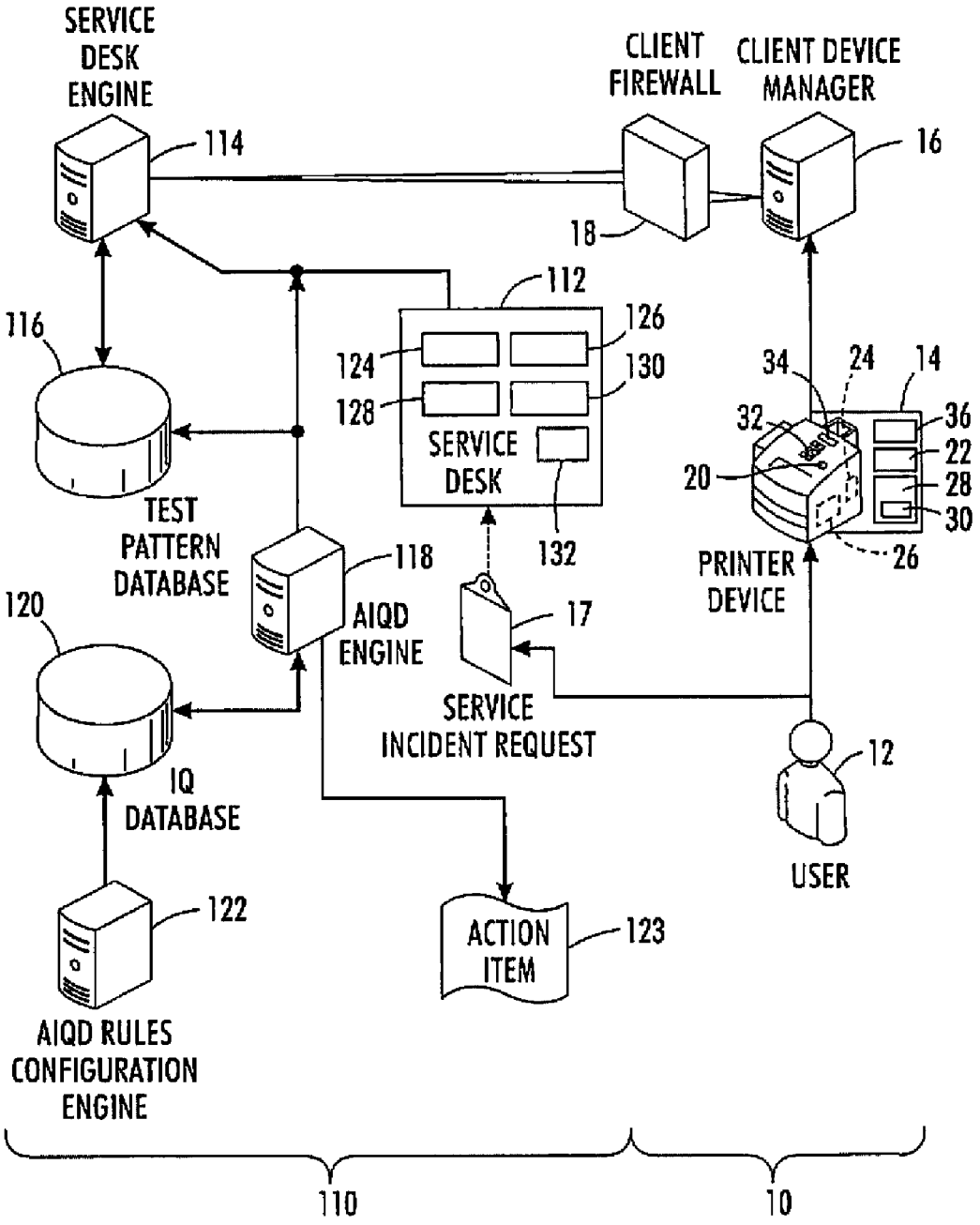

SERVICE DESK ENGINE
114
CLIENT FIREWALL
CLIENT DEVICE MANAGER
16
18
112
126
124
130
128
SERVICE DESK
116
TEST PATTERN DATABASE
118
AIQD ENGINE
132
17
SERVICE INCIDENT REQUEST
34
24
14
32
36
22
20
28
30
26
PRINTER DEVICE
120
IQ DATABASE
12
USER
122
AIQD RULES CONFIGURATION ENGINE
ACTION ITEM
123
110
10

FIG. 1

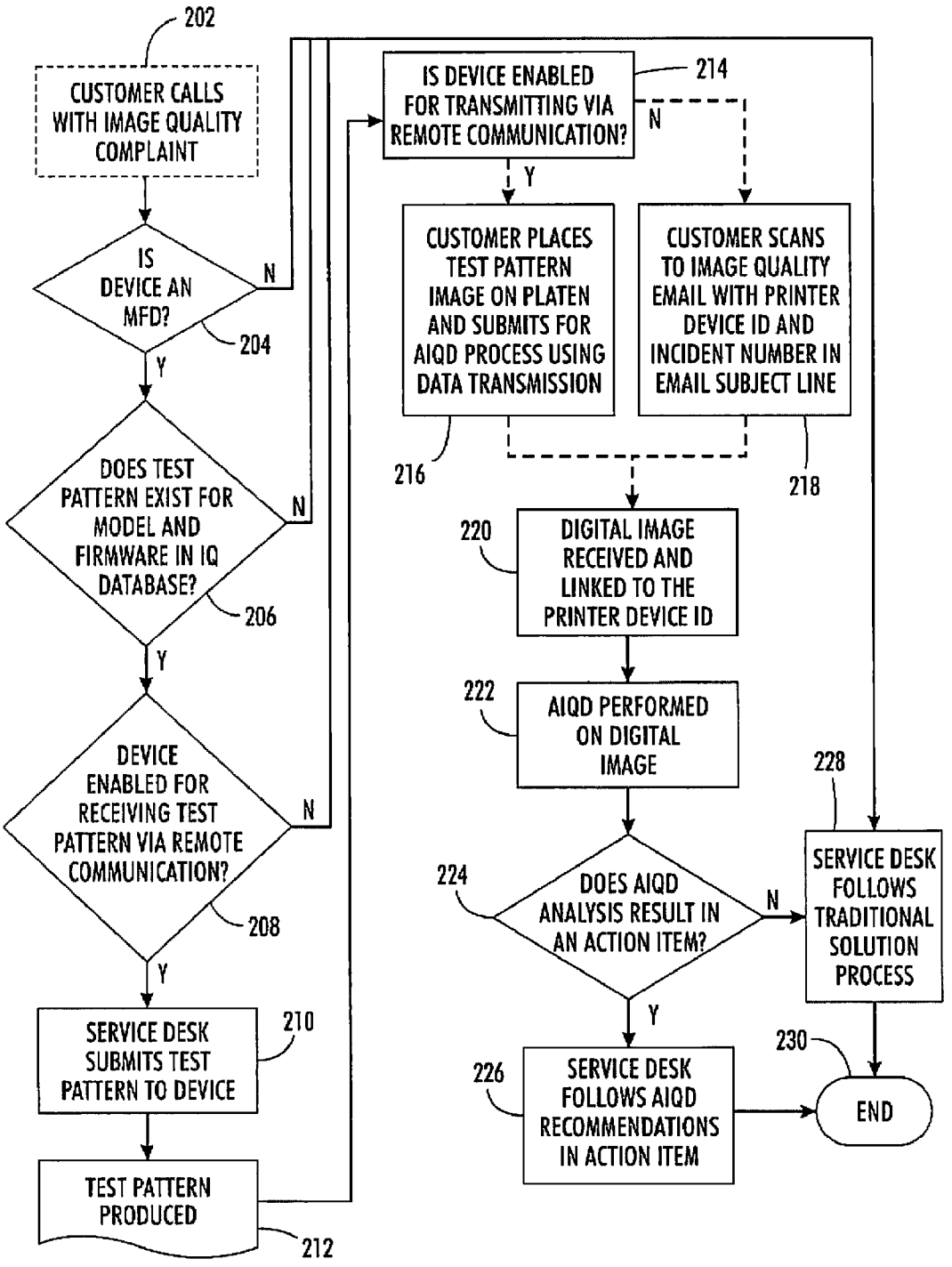

202
CUSTOMER CALLS WITH IMAGE QUALITY COMPLAINT
IS DEVICE AN MFD?
204
N
Y
DOES TEST PATTERN EXIST FOR MODEL AND FIRMWARE IN IQ DATABASE?
206
N
Y
DEVICE ENABLED FOR RECEIVING TEST PATTERN VIA REMOTE COMMUNICATION?
208
N
Y
SERVICE DESK SUBMITS TEST PATTERN TO DEVICE
210
TEST PATTERN PRODUCED
212
IS DEVICE ENABLED FOR TRANSMITTING VIA REMOTE COMMUNICATION?
214
N
Y
CUSTOMER PLACES TEST PATTERN IMAGE ON PLATEN AND SUBMITS FOR AIQD PROCESS USING DATA TRANSMISSION
216
CUSTOMER SCANS TO IMAGE QUALITY EMAIL WITH PRINTER DEVICE ID AND INCIDENT NUMBER IN EMAIL SUBJECT LINE
218
220
DIGITAL IMAGE RECEIVED AND LINKED TO THE PRINTER DEVICE ID
222
AIQD PERFORMED ON DIGITAL IMAGE
224
DOES AIQD ANALYSIS RESULT IN AN ACTION ITEM?
N
Y
226
SERVICE DESK FOLLOWS AIQD RECOMMENDATIONS IN ACTION ITEM
228
SERVICE DESK FOLLOWS TRADITIONAL SOLUTION PROCESS
230
END

FIG. 2

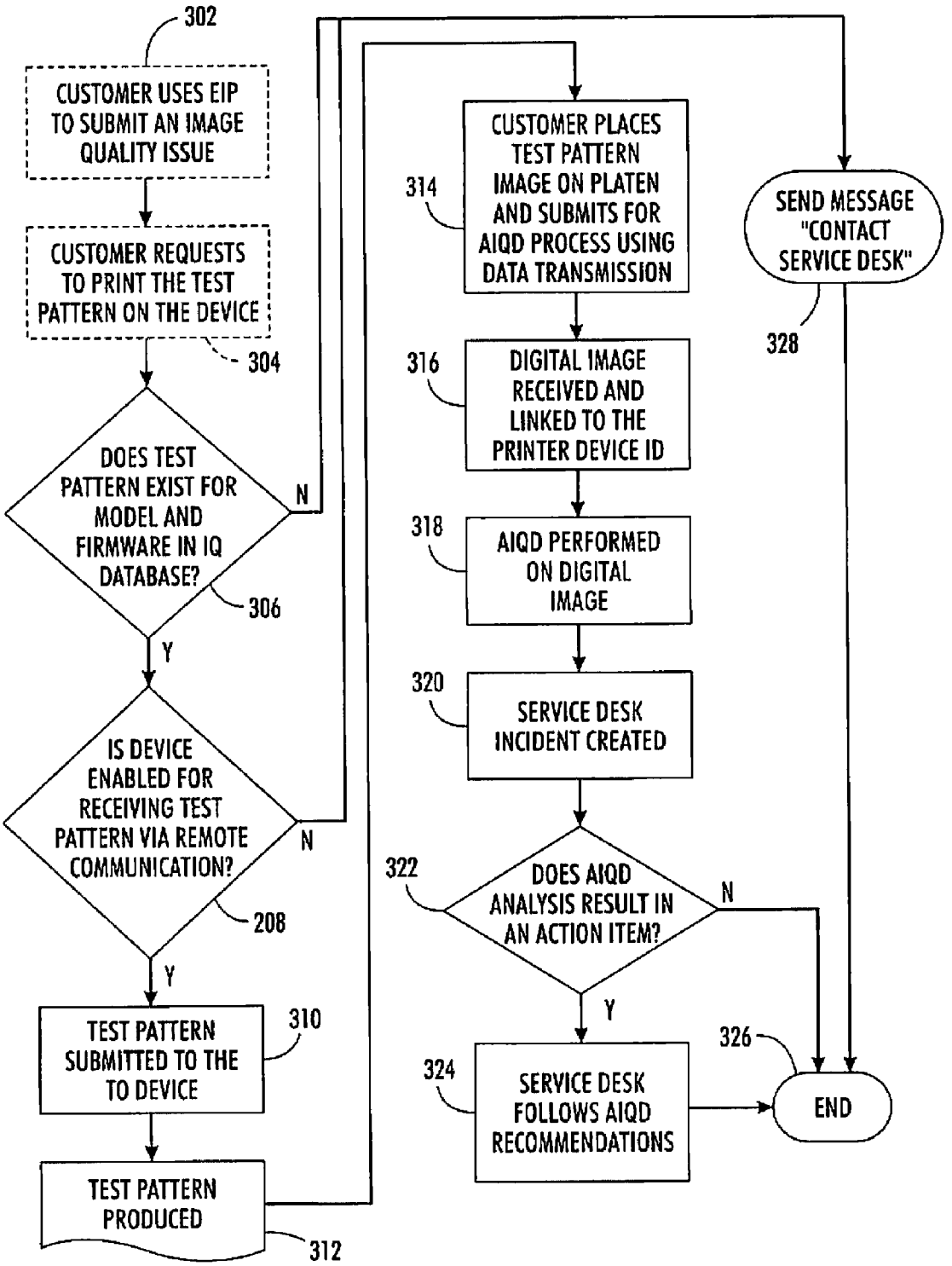

302
CUSTOMER USES EIP TO SUBMIT AN IMAGE QUALITY ISSUE
CUSTOMER REQUESTS TO PRINT THE TEST PATTERN ON THE DEVICE
304
DOES TEST PATTERN EXIST FOR MODEL AND FIRMWARE IN IQ DATABASE?
N
306
Y
IS DEVICE ENABLED FOR RECEIVING TEST PATTERN VIA REMOTE COMMUNICATION?
N
208
Y
TEST PATTERN SUBMITTED TO THE TO DEVICE
310
TEST PATTERN PRODUCED
312
CUSTOMER PLACES TEST PATTERN IMAGE ON PLATEN AND SUBMITS FOR AIQD PROCESS USING DATA TRANSMISSION
314
DIGITAL IMAGE RECEIVED AND LINKED TO THE PRINTER DEVICE ID
316
AIQD PERFORMED ON DIGITAL IMAGE
318
SERVICE DESK INCIDENT CREATED
320
DOES AIQD ANALYSIS RESULT IN AN ACTION ITEM?
322
N
Y
SERVICE DESK FOLLOWS AIQD RECOMMENDATIONS
324
SEND MESSAGE "CONTACT SERVICE DESK"
328
326
END

FIG. 3

SYSTEM AND METHOD FOR IMAGE QUALITY ANALYSIS AND DIAGNOSTICS

BACKGROUND

[0001] The present disclosure relates generally to image analysis of printer output and corresponding diagnostics of printer devices. In particular, the present disclosure relates to image analysis of printer output and corresponding diagnostics of printer devices from a remote location.

[0002] A printer user may notice that documents output by a printer device are defective, and conclude that the printer device is malfunctioning and needs to be serviced. The maintenance and repair service provider will want to know the nature of the problem before it dispatches a technician to the printer device site for analyzing and diagnosing the problem and determining if it is necessary to order parts or supplies. However, the service provider relies on the user's verbal description of the problem to understand the nature of the problem. The user may not know to look for or notice particular defects in the image on the defective document which will be useful in diagnosing the problem. Furthermore, while the user may recognize that something is wrong with the image, the image itself may not show enough information for diagnosing the problem.

SUMMARY

[0003] The present disclosure is directed to an image quality diagnostic system for diagnosing an image output by a printer device. The system includes at least one processor device communicating with a network for executing a series of programmable instructions for performing a method. The method includes receiving via the network from a remote node of the network a service incident report. The service report includes an indication of a type of a printer device, the printer device being disposed along the network at a location remote from the at least one processor device. The method further includes accessing a storage device storing a collection of test patterns, electronically selecting a test pattern from the collection of test patterns based on the type of the printer device, wherein the test pattern is configured as input that the printer device can receive and output corresponding printed output, and transmitting the selected test pattern via the network for the selected test pattern to be provided as input to the printer device.

[0004] The present disclosure is also directed to an image quality diagnostic system for diagnosing an image output by a printer device. The system includes at least one processor device communicating with a network for executing a series of programmable instructions for performing a method. The method includes receiving via the network from a remote node of the network an image of printed output output by a printer device, wherein the printed output corresponds to an input test pattern. Additionally, the method includes electronically selecting a set of at least one rule from a plurality of rules based on a type of the printer device, electronically analyzing the image for detecting a defect in the image by applying the selected set of at least one rule, electronically generating at least one recommendation for servicing the printer device based on the detected defect by applying the selected set of at least one rule, and outputting the at least one recommendation.

[0005] The present disclosure is also directed to a method for diagnosing image quality of a printer device's output. The method includes receiving by a processor, via a network from a remote node of the network, a service incident report. The incident report includes an indication of a type of the printer device the printer device being disposed along the network at a location remote from the processor. The method further includes accessing by the processor a storage device storing a collection of test patterns, selecting by the processor a test pattern from the collection of test patterns based on the type of the printer device, wherein the test pattern is configured as input that the printer device can receive and output corresponding printed output, and transmitting by the processor the selected test pattern for the selected test pattern to be provided as input to the printer device.

[0006] The present disclosure is further directed to a computer-readable medium storing a series of programmable instructions configured for execution by at least one processor for performing a method for diagnosing image quality. The method includes the steps of receiving a service incident report, wherein the service incident report includes an indication of a type of a printer device. The method further includes the steps of accessing a storage device storing a collection of test patterns, and selecting a test pattern from the collection of test patterns based on the type of the printer device, wherein the test pattern is configured as input that the printer device can receive and output corresponding printed output. Additionally, the method includes the steps of transmitting the selected test pattern for the selected test pattern to be provided as input to the printer device, receiving an image of printed output, wherein the printed output corresponds to the selected test pattern, and analyzing the image for detecting a defect in the image. The method finally includes the steps of generating at least one recommendation for servicing the printer device based on the detected defect, and outputting the at least one recommendation.

[0007] Other features of the presently disclosed image quality diagnostic system will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the presently disclosed image quality diagnostic system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Various embodiments of the present disclosure will be described below with reference to the figures, wherein:

[0009] FIG. **1** is a block diagram of an exemplary image quality diagnostic system in accordance with the present disclosure;

[0010] FIG. **2** is a flowchart of a diagnostic routine overseen by a human operator operated service desk and performed by the system shown in FIG. **1**; and

[0011] FIG. **3** is a flowchart of a diagnostic routine automatically performed by the system shown in FIG. **1**.

DETAILED DESCRIPTION

[0012] Referring now to the drawing figures, in which like references numerals identify identical or corresponding elements, the remote image quality diagnostics system and method in accordance with the present disclosure will now be described in detail. With initial reference to FIG. **1**, an exemplary image quality diagnostics (IQD) system in accordance with the present disclosure is illustrated and is designated generally as IQD system **100**. IQD system **100** includes a client side **10** and a server side **110**. On the client side, a user

12 operates at least one printer device **14**. Each printer device **14** may be in digital communication with a client device manager **16**. The client device manager **16** communicates digitally with the service provider side **110**, e.g., with a firewall disposed on the client side **10** and/or the service provider side **110**. In the present example a client firewall **18** is provided.

[0013] The printer device **14** may be a multi-function device having functionality in addition to printing, such as faxing and scanning. The term "printer device" as used herein encompasses any apparatus or system, such as a digital copier, xerographic printing system, ink jet printing system, reprographic printing system, bookmaking machine, facsimile machine, multifunction machine, textile marking machine, etc., which performs a marking output function for any purpose. The modality for marking may include, for example, applying toner, ink, dye, etc., to the substrate or embossing, peening, etching, etc. the substrate. The substrate may be a material such as paper, cardboard, a transparency, a paper derivative, metal, plastic, glass, wood, cloth, etc.

[0014] The printer device **14** may be provided with an input device **20** which is actuated when it is detected that an incident has occurred, where the incident includes the printer device **14** outputting a defective image. The input device **20** may be actuated by the user **12** when the user wishes to alert the service provider side **110** that an incident has been detected. The input device **20** may be a mechanical and/or electronic switch located on the printer device **14** that the user actuates, such as via a push button, swiping a card with a magnetic strip, etc. The input device **20** may be configured so that it can be actuated from a remote location by a user or a remote processor.

[0015] The printer device **14** is provided with a communication module **22** which includes hardware and software for enabling the printer device to communicate electronically with another processor, such as the client device manager **16**, for receiving instructions or print jobs. Additionally, the communication module **22** may be capable of communication via a network. This network communication may include the ability to transmit and receive data with another device, such as for receiving print jobs and transmitting output data. The output data may include status data indicating the status of a printing job, and may further include content data, such as data file corresponding to a scanned document. The network may be, for example, a LAN, WAN, intranet or the Internet. Accordingly, the network communication may include the ability to browse on the Internet, communicate with other devices, e.g., via email, send a data file, e.g., a scanned document, to a selected destination, e.g., as an email attachment.

[0016] As mentioned above, the printer device **14** may be a multi-function device (MFD)that is provided with a scanner device **24** that captures an image of a document and generates data that corresponds to the image. The scanner device **24** may include a glass plate or platen upon which the document being imaged is positioned for imaging thereof. The printer device **14** may further be provided with a transport device **26** that transports a printed document output by the printer device **14** to the platen of the scanner device **24** for scanning of the printed output document.

[0017] The printer device **14** is provided with a processor **28** that executes a software module **30**. The software module **30** at least controls the printer device **14** and its components to perform and synchronize the tasks performed by the various components. The printer device **14** is provided with a UI **32** (e.g., a keypad) and/or GUI **34** (e.g., a display screen) by which user **12** may input information to the processor **28** and receive output from the processor **28**. Input device **20** may be integrated with the UI **32**. The UI **32** and GUI **32** may be provided on a control panel **36** of the printer device **14**. Additionally, the printer device **14** includes a printer engine **36** which marks a substrate in accordance with a printing operation.

[0018] The client device manager **16** includes a processor **38**, a software module **40** executable on the processor **38**, and a communication device **42** for communicating digitally with another processor, e.g., via a network. The client device manager **16** may communicate digitally with one or more printer devices **14** and handle communication between the printer devices **14** and the service provider side **110**, such as by acting as an interface for communication between the printer device **14** and the service provider side **110**. Each message that the any of the printer devices **14** connected to the client device manager **16** transmits to the service provider side I **10** is transmitted to the client device manager **16**. The client device manager **16** then transmits the message to the service provider side **110**. Likewise, each message from the service provider side **110** that is transmitted to a printer device **14** on the client side **10** is transmitted via the client device manager **16**. The client device manager **16** receives the message from the service provider side **110** and provides the message to the appropriate printer device **14** targeted in the message. Each printer device **14** has an associated identification (ID) code that identifies the printer device **14**. The printer ID code may be included in messages sent by the printer device **14** for identifying the sender. The printer ID code may further be included in messages sent to the printer device **14** for identifying the printer device **14** that is the intended recipient.

[0019] In one embodiment, the printer device **14** is capable of communicating independently with the service provider side **110**. In this embodiment, the client device manager **16** may be omitted for the purposes of providing a communication interface between the printer device **14** and the service provider side **110**.

[0020] The client firewall **18** may include firewall software and/or hardware for maintaining a secure environment on the client side and only allowing appropriate messages to be transmitted from the service provider side **110** to the client device manager **16**. Firewall software and hardware is well known in the art. As mentioned above, the service provider side **110** may include a firewall as well for providing a secure environment on its side.

[0021] The service provider side **110** includes a service desk **112** operated by an operator which receives a request **17** to file a service incident report from the client side **10**, generates the service incident report and transmits it via data communication to a service desk engine **114** which further processes the service incident report and stores it in a test pattern database **116**.

[0022] Alternatively, the service desk engine **114** may receive the service incident report directly from the client side **10**. The service provider side **110** further includes an analysis and image quality definition (AIQD) engine **118** which accesses an image quality (IQ) database **120** and uses information retrieved from the IQ database **120** to further processes the service incident report and generate a solution. An AIQD rules configuration engine **122** is further provided on

the service provider side **110** for processing image quality data and generating AIQD rules that are stored in the IQ database **120**.

[0023] Each of the service desk engine **114**, the AIQD engine **118**, and the AIQD rules configuration engine **122** includes a respective processor and a software module executable by the processor. Furthermore, each of the service desk engine **114**, the AIQD engine **118**, and the AIQD rules configuration engine **122** includes a communication module including any necessary hardware and/or software for enabling the processor of the associated engine to communicate with another processor or to access a database in accordance with the functions described throughout.

[0024] Additionally, the test pattern database **116** is accessible by the processor(s) executing the software modules associated with the service desk engine **114** and the AIQD engine **118**. The IQ database **120** is accessible by the processor(s) executing the software modules associated with the AIQD engine **118** and the AIQD rules configuration engine **122**. The test pattern database **116** and the IQ database **120** each include hardware and software for storing, accessing and retrieving from a collection of at least one test pattern.

[0025] Any combination of the service desk engine **114**, test pattern database **116**, AIQD engine **118**, IQ database **120** and the AIQD rules configuration engine **122** may be integrated into a single unit, e.g., that is housed within a single housing and/or share one or more resources including their processor(s). Alternatively, any combination of the service desk engine **114**, test pattern database **116**, AIQD engine **118**, IQ database **120** and the AIQD rules configuration engine **122** may be remote from one another. The remote devices may communicate with one another via a bus, wired or wireless communication device, and/or a network, such as a LAN, WAN, intranet or the Internet.

[0026] The test patterns stored in the test pattern database **116** include printer ready files that may be input to a printer, such as printer device **14**, and a request to print the printer ready file. Upon receiving the test pattern, the printer prints the test pattern. The test pattern's printer ready file includes data to be printed and instructions in how it should be printed, e.g., how it is to be laid out and formatted for producing one or more images that are printed on a substrate. The printer ready files are configured to require the printer device **14** utilize various components of its print engine to produce the image(s) so that the image(s) produced will indicate if a component has a defect.

[0027] Each test pattern is designed for a particular printer for testing the particular hardware of the printing engine and/or other particular hardware and/or software used by the printer when printing the test pattern. The test patterns are each associated with a type of printer, such as for compatibility with a particular model or make of printer, and/or a particular set of firmware used by the printer. In one embodiment, the test pattern may not be configured to be compatible with the printer device **14** it is meant to print on and may need to undergo a conversion process for ensuring compatibility. The conversion may be performed at the service provider side **110**, e.g., by the service desk **112** via its workstation or the service desk engine **114**, or on the client side **10**, e.g., by client device manager **16** or the user **12** via his workstation.

[0028] The rules stored in the IQ database **120** include logic and/or instructions to be applied to image quality analysis performed by the AIQD engine for correlating a defect detected in an image to a defect in a physical component of the printer that printed the image. Furthermore, the rules may correlate possible defects in the physical components of the printer with an action item, such as a recommendation in how to fix the defective components and what parts need to ordered. The rules are stored as sets of rules, with each set of rules designed for a particular printer for making determinations based on the particular hardware of the printing engine and/or other particular hardware and/or software used by the printer when printing the test pattern. The sets of rules are each associated with a type of printer, such as a particular model or make of printer, and/or a particular set of firmware used by the printer.

[0029] Each set of rules includes a series of rules to run against a particular test pattern, with each rule including instructions and logic describing the rule so that the rule is executable. The rules typically include a test to be applied to the image of the printed test pattern and pass or fail metrics based on boundary conditions such as a threshold range for some attribute. For example, a rule might includes instructions for measuring image skew on the image of the printed test pattern and for comparing to the expected skew for the particular test pattern file.

[0030] The rule would also contain a tolerance range for the image skew and logic to determine if the skew of the image of the printed test pattern was within the tolerance range or not, which would further determine if the image of the printed test pattern passed or failed on the rule. Rule failure indicates a defect in the image of the printed test pattern. As described further below, the rules and the boundary conditions provided with rules are configurable. Image attributes that the test patterns and the rules examine include image rotation, image skew, grey scale accuracy, line width, accuracy of frequency patterns in the image (which may be an indicator of component failure). The rules further correlate the defect in the image of the printed test pattern to possible defects in the physical components of the printer. Additionally, the rules correlate defects in the printer with respective action items.

[0031] The IQ database may further include historical data from which the AIQD rules configuration engine may make inferences. The historical data may include, for example, which test pattern was used and which rules were applied in association with a service incident report and feedback data indicating success in applying the rules

[0032] The service desk **112** includes a first communication device **124** for receiving the request **17** to file a service incident report from the client side **10**, a second communication device **126** for communicating with the service desk engine **114**. The request **17** may be received in a variety of forms, such as in the form of a phone call, electrical signal (analog or digital), or an email. The service desk **112** is provided with a workstation including a processor **128** for receiving information included in the request **17** received from the client side **10** and generating the service incident report. The workstation may include UI **130** for entering information into the processor, and a display device for displaying information to the operator. The first and/or the second communication devices **124** and **126** may be integrated with the workstation. It is also possible that the first and second communication devices **124** and **126** are configured as a single communication device. The first communication device **124** may be a telephone or a data communication device that is in data communication with the printer device **14** or the client device manager **16** via a communication medium (not shown), such as is known in

the art for wired or wireless communication, e.g., via a network, such as an intranet or the Internet.

[0033] The service incident report is a message indicating that an incident has occurred with a printer device **14**, e.g., that the printer device **14** output a defective image, and includes the ID code of the printer device **14**. It may further include a cursory description of the problem associated with the incident that is being reported.

[0034] In one embodiment the user **12** requests generation of a service incident report by placing a telephone call to the first communication device **124** (which in this example is a telephone). The operator of the service desk **112** answers the telephone and enters the information corresponding to the request **17** into the processor **128** via the UI **130**. The information corresponding to the request **17** indicates that an incident is being reported in connection with a printer device **14** and includes the ID code of the printer device **14**, and may further include the description of the problem. The operator may be provided with a GUI displayed on the display device **132**, such as an entry form with entry areas for entering information associated with the incident being reported. The GUI may provide the operator with a menu (e.g., a drop-down menu) of problem descriptions to select from. Once the operator has entered the information to be included in the service incident report, the service incident report is generated by the processor **128** and transmitted as a digital message via the second communication device **126** to the service desk engine **114**.

[0035] In another method of initiating generation of a service incident report in accordance with another embodiment of the IQD system **100**, the input device **20** associated with the printer device **14** is actuated by user **12**, which causes the printer device **14** to generate a digital message that includes the printer device's **14** ID code, and to transmit the service incident report to the service provider side **110**. The message is received by the service desk **124** as a request to transmit a service incident report. The service desk **124** formats the information included in the message into a service incident report and transmits the service incident report to the service desk engine **114**.

[0036] Alternatively, the message may already be formatted properly as a service incident report and may be transmitted by the printer device **14** to the service desk engine **114** without involvement by the service desk **124**. In this embodiment the service desk **124** may be omitted from the IQD system **100** or only used for handling service incident reports associated with printers that do not have the input device **20** or the capability of transmitting the service incident report digitally to the service desk engine **114**. In this embodiment the printer device **14** communicates with the service desk engine **114**, such as via the communication module **22** and the Internet, without involving the client device manager **16** in the communication.

[0037] In still another method of initiating generation of a service incident report in accordance with another embodiment of the IQD system **100** in which the service desk **124** may not be needed, the client device manager **16** is notified about the incident and generates a digital service incident report that includes the ID code of the printer **14** that is malfunctioning and possibly the nature of the problem being reported. The client device manager **16** is notified about the incident either via the printer device **14** that is malfunctioning, such as in response to actuation of the input device **20**, or via notification from the user **12** by means of another processor, such as a workstation operated by the user **12**. The workstation may execute a software module including a series of programmable instructions that provides the user **12** with a GUI for entering a request **17** to submit a service incident report, where the request **17** includes the printer device ID and may include a brief description of the problem, e.g., via a menu of selections. The software module arranges for the request **17**, once entered, to be transmitted to the client device manager **16**.

[0038] The client device manager **16** transmits the request **17** to the service provider side **110**. The request **17** may be received by the service desk **124** which generates the service incident report and transmits it to the service desk engine **114**. Alternatively, the request **17** may already be formatted properly as service incident report and may be transmitted by the client device manager **16** to the service desk engine **114**, without any involvement by the service desk **124**. The formatting of the request **17** into a proper service incident report may have been performed at the workstation operated by the user **12** or by the client device manager **16**.

[0039] Upon receipt of the service incident report the service desk engine **114** accesses the test pattern database **116**, retrieves an appropriate test pattern based on the printer device ID code included in the service incident report from the test pattern database **116** and the description of the problem (if included), and electronically transmits the retrieved test pattern as a printer ready data file to the client side **10**. The service desk engine **114** uses the printer device ID to determine the make and model of the printer device **14** associated with the service incident report. This may be done by accessing a local or remote database that associates the printer device ID to the make and model of the associated printer device.

[0040] In one embodiment, the retrieved test pattern is transmitted as a data file to the printer device **14** via the client device manager **16**. From the printer device's **14** perspective the received test pattern is a print job and upon receipt of the test pattern the printer device **14** prints the test pattern.

[0041] In another embodiment, the test pattern is transmitted by the service desk engine **114** to the printer device **14** without involvement of the client device manager **16**, such as via the Internet in conjunction with the printer device's **14** communication module **22**. In this embodiment the transmitting of the test pattern to the printer device **14** by the service desk engine **114** is performed in a single transmission operation, which means that the service desk engine **114** initiates the transmission via the Internet, and the printer device **14** receives the test pattern via the Internet and via the same transmission. In other words, the address destination of the Internet transmission of the test pattern by the service desk engine **114** is the printer device **14**.

[0042] Alternatively, the test pattern is transmitted to the client device manager **16**, which in turn transmits the test pattern to the appropriate printer device **14**. The test pattern transmission to the client device manager **16** includes the ID code for the printer device **14** in order that the client device manager **16** can route the test pattern to the appropriate printer device **14**.

[0043] The printer device **14** prints the test pattern and outputs a printed test pattern. The printed test pattern is scanned in and the corresponding image is transmitted back to the service provider side **110** for analysis by the AIQD engine **118**. Transmission of the image corresponding to the scanned test pattern printout may be directly from the printer

device **14** to the AIQD engine **118** or may be via the client device manager **16** and/or the service desk engine **114**.

[0044] The process of scanning the printed test pattern and transmitting it to the service provider side **110** may be performed entirely by the printer device **14** with or without user intervention. For example, if the printer device **14** is provided with scanner device **24** and transport device **26**, the printed test pattern is printed by the printer device **14**, transported to the scanner device **24** by the transport device **26**, scanned in by the scanner device **24**, and the data generated by the scanner device **24** (herein referred to as the scanned test pattern) is transmitted to the service provider side **110** or the client device manager **16** via communication module **22**, e.g., via the Internet as an attachment to an email transmitted to the service desk engine **114** or the AIQD engine **118**. In the absence of a transport device **26**, a user physically transports the printed test pattern to the scanner device **24** or a remote scanner device if the printer device **14** does not include scanner device **24**. The user may actuate transmission of the scanned test pattern to the service provider side **110** or to the client device manager **16** via communication module **22**, such as by entering a user command via UI **32** and/or GUI **34**.

[0045] Transmission of the scanned test pattern may be automatic upon completion of the scan operation without any user intervention. When the scanned test pattern is transmitted to the client device manager **16**, the client device manager **16** it transmits the scanned test pattern to the service provider side **110**. When the scanned test pattern is transmitted by the printer device **14** to the service provider side **110** (e.g., the service desk engine **114** or the AIQD engine **118**) the service provider side **110** receives the scanned test pattern via the Internet from the printer device **14** by a single transmission operation, which means that the printer device **14** initiates the transmission via the Internet, and the service provider side **110** receives the test pattern via the Internet and via the same transmission. In other words, the address destination of the Internet transmission of the scanned test pattern by the printer device **14** is the service desk engine **114** or the AIQD engine **118**.

[0046] If the printer device **14** does not have the capability of communicating with client device manager **16** or the service provider side **110**, the scanned test pattern may be stored on a computer readable storage device and retrieved by any processing device having communication capability which can transmit the scanned test pattern to the service provider side **110**. The transmission by any device of the scanned test pattern to the service provider side **110** includes the scanned test pattern and an identification of the service incident report and printer device **14** it is associated with.

[0047] Where the printer device **14** is capable of digitally communicating with the service provider side **110** a diagnostic routine may be initiated at regular intervals, even when service incident report is not generated. The diagnostic routine may be automatically initiated by the client side **10** or the service provider side **110**. The printer device **14** or the client device manager **16** may initiate the diagnostic routine by requesting a test pattern, or the service desk engine **114** may initiate the diagnostic routine by transmitting an appropriate test pattern retrieved from the IQ database **120**. The rest of the diagnostic routine may proceed automatically or with user intervention, as described below. By providing diagnostics at regular intervals an image quality problem may be detected and diagnosed before the problem becomes noticeable to a user and the printed output significantly degraded.

[0048] The IQ database **120** stores a collection of rules for analyzing images, such as the scanned test patterns, in order to find defects in the images. Additionally, the rules may help to determine possible causes of the defects. The rules stored by the IQ database **120** are continually updated or reconfiured by the AIQD rules configuration engine **122** as more knowledge becomes available. The knowledge may be knowledge that becomes available about defects in printer devices, and particularly in specific makes and models of printer devices. For example, the knowledge may become available through studying the specific printer devices and their printed test patterns, simulating or experimentally causing defects in the printer devices and studying the resulting printed test patterns, and studying trends in image quality failures associated with specific printer devices based on analysis of historical image quality analysis results.

[0049] The image quality analysis detects defects in the image, if any, correlates each detected image defect with one or more defects in the software and/or hardware of the associated printer device, and recommends a solution for remedying each correlated printer device defect. The recommended solution is used to generate an action item **123**. The action item **123** may be communicated to the client side **10**. The rules and/or recommended action items **123** may have associated strengths. As knowledge becomes available as to the success in applying the rules to correlate the image defects to printer hardware and/or software defects, the rules and/or the strength of the rule may be adjusted accordingly. Furthermore, as knowledge becomes available as to success or lack thereof with respect to applying the recommended action items **123**, the rules and/or the strength of the rules is adjusted accordingly.

[0050] The action item **123** is used to arrange for the defect to be remedied, which may include recommendations for ordering a technician to be dispatched with instructions of what to do to repair the printer device, and may further include recommendations for ordering any parts that may be needed for repairing the printer device. The action item **123** may be transmitted to the service desk **124** to allow the operator to order the necessary parts and to schedule and dispatch the technician with the instructions generated with the action item **123**. The action item **123** may alternatively be provided to a processor which executes a software module including a series of programmable instructions. The processor may generate a request for the parts that need to be ordered, and further generate a request for a technician who has the necessary expertise (in accordance with the generated instructions) and is located in the region that the associated printer device is located in. The processor can be programmed to submit the order to the parts manufacturer with directions for delivery of the parts to a proper location. The processor can further be programmed to schedule a technician and inform the technician as to the schedule and the task that needs to be performed, including the instructions generated in the action item **123**.

[0051] After an image quality analysis is performed on a scanned test pattern the results are stored in the IQ database **120**. Accordingly, the IQ database **120** and/or the AIQD rules configuration engine **122** is updated with the results of the image quality analysis performed by the AIQD engine **118**. Accordingly, the AIQD engine **118** may store the results in the IQ database **120** or communicate the results of its analysis to the AIQD rules configuration engine **122** which will in turn store the information in the IQ database **120**. Since the rules

stored in the IQ database are based on patterns recognized that indicate relationships between particular printers, defects and possible solutions, the detection of a defect and the determination of a solution are data that the AIQD rules configuration engine **122** can be used to establish new patterns and to generate new rules or update the rules and/or the associated strengths stored in the IQ database **120**.

[0052] Furthermore, feedback related to implementation of the action item and the success or lack thereof of is communicated to the AIQD rules configuration engine for updating the rules or increasing the strength of the rules. After implementing the action item, in one embodiment, the user **12** reports the outcome (e.g., if the printer device **14** is successfully repaired or if the printer device **14** is still printing defective images) to the service desk **112** which provides the information to the AIQD rules configuration engine **122**. The test pattern may be reprinted by the printer device (either the test pattern was stored by the printer device **14** or resent by the service desk engine **114**) and sent to the service provider side **110** for reanalysis to confirm that the outcome reported by the user **12**.

[0053] In another embodiment, user **12** informs the service provider side **110** (e.g., by actuating input device **20** on the printer device **14**) that the action item was implemented, after which the test pattern is automatically reprinted by printer device **14** (either the test pattern was stored by the printer device **14** or it is resent by the service desk engine **114**), the printed test pattern is scanned (either automatically, using the scanner device **24** and the transport device **26** or via intervention by user **12**), and the scanned test pattern is provided to the AIQD engine **118** for analysis (either by the printer device **14**, automatically or with user intervention, or by user intervention using another processor to transmit the scanned test pattern). The AIQD engine **118** determines if the printer device **14** was properly repaired, provides the knowledge to the AIQD rules configuration engine **122** for updating the rules and/or their strengths, and recommends an additional action item if repairs are still necessary.

[0054] Each software module described above includes a series of programmable instructions capable of being executed by the associated processor. The series of programmable instructions can be stored on a computer-readable medium, such as RAM, a hard drive, CD, smart card, 3.5" diskette, etc., or transmitted via propagated signals for being executed by the associated processor for performing the functions disclosed herein and to achieve a technical effect in accordance with the disclosure. The functions of the respective software modules may be combined into one module or distributed among a different combination of modules.

[0055] Referring to FIG. **2**, a method of performing a diagnostic procedure when initiated by user **12** is shown. At step **202**, a customer, e.g., user **12**, calls with a complaint about quality of a printed image output by printer device **14** and provides the printer ID of printer device **14**. At decision step **204**, the printer ID is used to determine if the printer device **14** is an MFD. This can be done by looking up information about the printer device **14** using the printer ID on a local or remote database. If so, control passes to step **206**, and if not, control passes to step **228**. Alternatively, control could pass to step **218** in which a scanner that is not included with the printer device **14** is used to capture an image of the printed test pattern. At decision step **206**, the printer ID is used to determine if a test pattern is stored in test pattern database **116** for the make and model and firmware of the printer device **14**. If so, step **208** is executed. If not, step **228** is executed. At decision step **208**, the printer ID is used to determine if printer **14** is remote communication enabled, e.g., for receiving the test pattern from the service desk **112**. If so, (e.g., the printer device **14** can receive the test pattern via a communication link (e.g., via a network, such as the Internet) with the service desk **112**, or via the client device manager **16** which received it from the service desk **112**) control passes to step **210**, and if not, control passes to step **228**. At step **210**, the service desk **112** submits the test pattern to the printer device **14**. At step **212**, the printer device **14** prints the test pattern. At decision step **214**, the printer ID is used to determine if the printer device **14** has an interface for communicating with the service provider side **110**, e.g., via the Internet. If so, control passes to step **216**, and if not, control passes to step **218**. At step **216**, the printed test pattern is scanned in by the printer device **14** and the scanned test pattern is sent via the communication interface to the service provider side **110**. The communication sent via the communication interface includes the printer ID for printer device **14** and an ID that is associated with the incident being reported for service, herein referred to as an incident ID. The scanning may be performed by placing the printed test pattern on the platen of the scanner device that is integrated with the printer device **14**, where the placing is performed by the user **12** or the transport device **26**, if available. The scanned test pattern may be sent over the Internet, such as via an email sent from the printer device **14** to the service desk **112** or to the service desk engine **114**. The image of the printed test image may be included in the body of the email or provided as an attachment to the email The printer ID and incident ID may included in the body of the email or in the subject field of the email At step **218**, the user **12** may scan the printed test pattern, either using the scanner device **24** integrated with the printer device **14** or using a remote scanner device. The output from the scanner device is transmitted by the user **12**, e.g., as an attachment to an email sent via the Internet. The email must specify, e.g., in the subject line, the printer ID and the incident ID.

[0056] At step **220**, the scanned test pattern transmitted in step **216** or **218** is received by the service provider side **110** (e.g., the service desk **112** or the service desk engine **114**). At step **222**, the AIQD engine **118** uses the printer ID to look up rules in the IQ database **122** to apply to the image of the scanned test pattern for analyzing the image. At decision step **224**, a determination is made if the analysis performed in step **224** resulted in generation of an action item including an alert or a recommendation. An alert may include a message indicating a defect in the image of the printed test pattern, such as that its skew is outside of the tolerance threshold range, that grayscale or color measurements associated with the image are out of a selected tolerance threshold range, or that objects in the image are not located in correct positions when measured against the test pattern. The recommendations generated may include a recommendation to order a part or a recommendation to dispatch a technician to service the printer in accordance with specific instructions. If the determination at step **224** is positive, then step **226** is executed, otherwise, step **228** is executed. At step **226**, the service desk **112** follows the recommendations, such as by ordering the part and scheduling and dispatching the technician with the specific instructions. Next, at step **230**, the diagnostic procedure is completed and terminated. At step **228**, the service desk **112** follows a traditional process by recording user's description of the problem and dispatching a technician to

evaluate the problem, after which the diagnostic procedure ends at step **230**. Step **228** is reached when the method of supplying the test pattern to the printer device **14** and analyzing the scanned test pattern is not possible or successful.

[0057] With reference to FIG. **3**, a method of performing a diagnostic procedure when initiated by the printer device **14** or the client device manager **16** is shown. At step **302**, the user **12** initiates a diagnostic procedure, such as via UI **32** of the printer device **14**. The procedure may also be initiated by the printer device **14** itself, such as in response to a trigger such as an event or the occurrence of completion of a time interval (e.g., where a diagnostic procedure is performed at regular time intervals). The procedure may also be initiated by the service provider side **110** in response to a similar trigger, where the service provider side **110** sends a message to the printer device **14** to begin the diagnostic procedure. At step **304**, the service incident report is transmitted by the printer device **14** via communication module **22** to the service desk engine **114**. At decision step **306**, the printer ID is used to determine if a test pattern is stored in test pattern database **116** for the make and model and firmware of the printer device **14**. If so, step **308** is executed. If not, step **328** is executed.

[0058] At decision step **308**, the printer ID is used to determine if printer **14** is remote control enabled, e.g., for receiving the test pattern from the service desk **112**. If so, (e.g., the printer device **14** can receive the test pattern via a communication link with the service desk **112**, or via the client device manager **16** which received it from the service desk **112**) control passes to step **310**, and if not, control passes to step **328**. At step **310**, the service desk engine **114** submits the test pattern to the printer device **14** via the printer device's **14** communication module **22**. At step **312**, the printer device **14** prints the test pattern. At step **314**, the printed test pattern is scanned in by the printer device **14** and the scanned test pattern is sent via the communication interface to the service provider side **110**. The communication sent via the communication interface includes the printer ID for printer device **14** and the incident ID. The scanning may be performed by placing the printed test pattern on the platen of the scanner device that is integrated with the printer device **14**, where the placing is performed by the user **12** or the transport device **26**, if available. The scanned test pattern is sent over the Internet, such as an attachment to an email sent from the printer device **14** to the service desk engine **114**.

[0059] At step **316**, the scanned test pattern transmitted in step **314** is received by the service provider side **110** (e.g., the service desk engine **114**). At step **318**, the AIQD engine **118** uses the printer ID to look up rules in the IQ database **122** to apply to the image of the scanned test pattern for analyzing the image. At step **320**, a service desk incident is created which includes a link to the image of the printed test image, and a link to the printer device **14** which caused the incident and information related to the incident, such as tracking information about any supplies ordered or technicians dispatched, comparison of the tracked information to contracted response and resolution time criteria. At decision step **322**, a determination is made if the analysis performed in step **318** resulted in generation of an alert or a recommendation. The alert describes one or more defects detected in the image of the printed test pattern. The recommendations generated may include a recommendation to order a part or a recommendation to dispatch a technician to service the printer in accordance with specific instructions.

[0060] If the determination at step **322** is positive, then step **324** is executed, otherwise, step **326** is executed in which the diagnostic procedure is completed and terminated. At step **324**, the service desk **112** follows the recommendations, such as by ordering the part and scheduling and dispatching the technician with the specific instructions. Next, at step **326**, the diagnostic procedure is completed and terminated. At step **328**, the service desk engine **114** returns a message to the printer device **14** that the diagnostic procedure was unsuccessful since communication between the service desk engine **114** and the printer device **14** failed. The message recommends that service desk **112** be contacted.

[0061] It will be appreciated that variations of the above-disclosed and other features and functions, or alternatives thereof, may be desirably combined into many other different systems or applications. Also that various presently unforeseen or unanticipated alternatives, modifications, variations or improvements therein may be subsequently made by those skilled in the art which are also intended to be encompassed by the following claims.

What is claimed is:

1. An image quality diagnostic system for diagnosing an image, the system comprising:

at least one processor device communicating with a network for executing a series of programmable instructions for performing the method of:

receiving via the network from a remote node of the network a service incident report including an indication of a type of a printer device, the printer device being disposed along the network at a location remote from the at least one processor device;

accessing a storage device storing a collection of test patterns;

electronically selecting a test pattern from the collection of test patterns based on the type of the printer device, wherein the test pattern is configured as input that the printer device can receive and output corresponding printed output; and

transmitting the selected test pattern via the network for the selected test pattern to be provided as input to the printer device.

2. The image quality diagnostic system in accordance with claim **1**, wherein the method performed in accordance with execution of the series of software instructions by the at least one processor device further comprises:

receiving via the network an image of printed output, wherein the printed output corresponds to the selected test pattern; and

electronically analyzing the image for detecting a defect in the image.

3. The image quality diagnostic system in accordance with claim **2**, wherein the method performed in accordance with execution of the series of software instructions by the at least one processor device further comprises:

electronically generating at least one recommendation for servicing the printer device based on the detected defect; and

outputting the at least one recommendation.

4. The image quality diagnostic system in accordance with claim **2**, wherein the analyzing includes selecting a set of at least one rule from a plurality of rules based on at least one of the type of the printer device, and the test pattern that was selected, and applying the selected set of at least one rule.

5. The image quality diagnostic system in accordance with claim 4, wherein respective rules of the plurality of rules are associated with a type of printer device and are configured to detect a defect in the image and correlate the detected defect to a defect in a printer device of the type of printer device associated with the rule.

6. The image quality diagnostic system in accordance with claim 4,

wherein the method performed in accordance with execution of the series of software instructions by the at least one processor device further comprises:

electronically generating at least one recommendation for servicing the printer device based on the detected defect;

receiving feedback information related to improvement in printed output corresponding to the selected test pattern output by the printer device after implementing the at least one recommendation; and

updating the plurality of rules with the feedback information.

7. The image quality diagnostic system in accordance with claim 3, wherein the at least one recommendation includes recommending at least one of instructions to be performed by a technician and ordering at least one part.

8. The image quality diagnostic system in accordance with claim 1, wherein the network is the Internet, and the transmitting the test pattern includes transmitting the test pattern digitally to the printer device via the network by a single transmission operation.

9. The image quality diagnostic system in accordance with claim 2, wherein the network is the Internet, and the receiving the image of the printed output includes receiving the image of the printed output from the printer device via the network by a single transmission operation.

10. An image quality diagnostic system for diagnosing an image, the system comprising:

at least one processor device communicating with a network for executing a series of programmable instructions for performing the method of:

receiving via the network from a remote node of the network an image of printed output output by a printer device, wherein the printed output corresponds to an input test pattern;

electronically selecting a set of at least one rule from a plurality of rules based on a type of the printer device;

electronically analyzing the image for detecting a defect in the image by applying the selected set of at least one rule;

electronically generating at least one recommendation for servicing the printer device based on the detected defect by applying the selected set of at least one rule; and

outputting the at least one recommendation.

11. The image quality diagnostic system in accordance with claim 10, wherein respective rules of the plurality of rules are associated with a type of printer device and are configured to detect a defect in the image and correlate the detected defect to a defect in a printer device of the type of printer device associated with the rule.

12. The image quality diagnostic system in accordance with claim 10, wherein the method performed in accordance with execution of the series of software instructions by the at least one processor device further comprises:

receiving feedback information related to improvement in printed output corresponding to the selected test pattern output by the printer device after implementing the at least one recommendation; and

updating the plurality of rules with the feedback information.

13. The image quality diagnostic system in accordance with claim 10, wherein the at least one recommendation includes recommending at least one of instructions to be performed by a technician and ordering at least one part.

14. The image quality diagnostic system in accordance with claim 10, wherein the network is the Internet, and the receiving the image of the printed output includes receiving the image of the printed output from the printer device via the network by a single transmission operation.

15. A method for diagnosing image quality comprising:

receiving by a processor, via a network from a remote node of the network, a service incident report including an indication of a type of the printer device the printer device being disposed along the network at a location remote from the processor;

accessing by the processor a storage device storing a collection of test patterns;

selecting by the processor a test pattern from the collection of test patterns based on the type of the printer device, wherein the test pattern is configured as input that the printer device can receive and output corresponding printed output; and

transmitting by the processor the selected test pattern for the selected test pattern to be provided as input to the printer device.

16. The method in accordance with claim 15, comprising:

receiving via the network by the processor an image of printed output, wherein the printed output corresponds to the selected test pattern; and

analyzing by the processor the image for detecting a defect in the image.

17. The method in accordance with claim 16, comprising:

generating at least one recommendation by the processor for servicing the printer device based on the detected defect; and

outputting by the processor the at least one recommendation.

18. The method in accordance with claim 17, wherein the at least one recommendation includes recommending at least one of instructions to be performed by a technician and ordering at least one part.

19. The method in accordance with claim 15, wherein the network is the Internet, and the transmitting the test pattern includes transmitting the test pattern digitally to the printer device via the network by a single transmission operation.

20. The method in accordance with claim 16, wherein the network is the Internet, and the receiving the image of the printed output includes receiving the image of the printed output from the printer device via the network by a single transmission operation.

21. A computer-readable medium storing a series of programmable instructions configured for execution by at least one processor for performing a method for diagnosing image quality, the method comprising the steps of:

receiving a service incident report including an indication of a type of a printer device;

accessing a storage device storing a collection of test patterns;

selecting a test pattern from the collection of test patterns based on the type of the printer device, wherein the test pattern is configured as input that the printer device can receive and output corresponding printed output;

transmitting the selected test pattern for the selected test pattern to be provided as input to the printer device;

receiving an image of printed output, wherein the printed output corresponds to the selected test pattern;

analyzing the image for detecting a defect in the image;

generating at least one recommendation for servicing the printer device based on the detected defect; and

outputting the at least one recommendation.

22. The computer-readable medium in accordance with claim **21**, wherein the at least one recommendation includes recommending at least one of instructions to be performed by a technician and ordering at least one part.

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