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**Schultz et al.**

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(54) **SYSTEM AND METHODS FOR DETECTION OF NEW MALICIOUS EXECUTABLES**

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(51) **Int. Cl.**
***G06F 21/00*** (2006.01)

(52) **U.S. Cl.** ..... **726/24**; 713/188

(58) **Field of Classification Search** ..... 726/13, 726/22–25; 713/156, 188; 709/206, 207, 709/225

See application file for complete search history.

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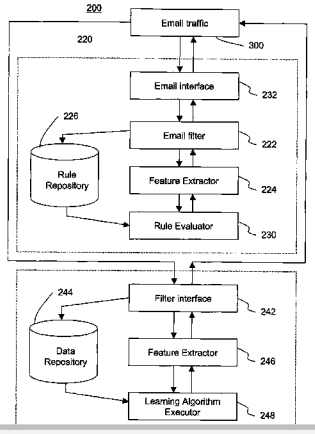
(57) **ABSTRACT**

A system and methods for detecting malicious executable attachments at an email processing application of a computer system using data mining techniques. The email processing application may be located at the server or at the client or host. The executable attachments are filtered from said email, and byte sequence features are extracted from the executable attachment. The executable attachments are classified by comparing the byte sequence feature of the executable attachment to a classification rule set derived from byte sequence features of a data set of known executables having a predetermined class in a set of classes, e.g., malicious or benign. The system is also able to classify executable attachments as borderline when the difference between the probability that the executable is malicious and the probability that the executable is benign are within a predetermined threshold. The system can notify the user when the number of borderline attachments exceeds the threshold in order to refine the classification rule set.

**43 Claims, 7 Drawing Sheets**



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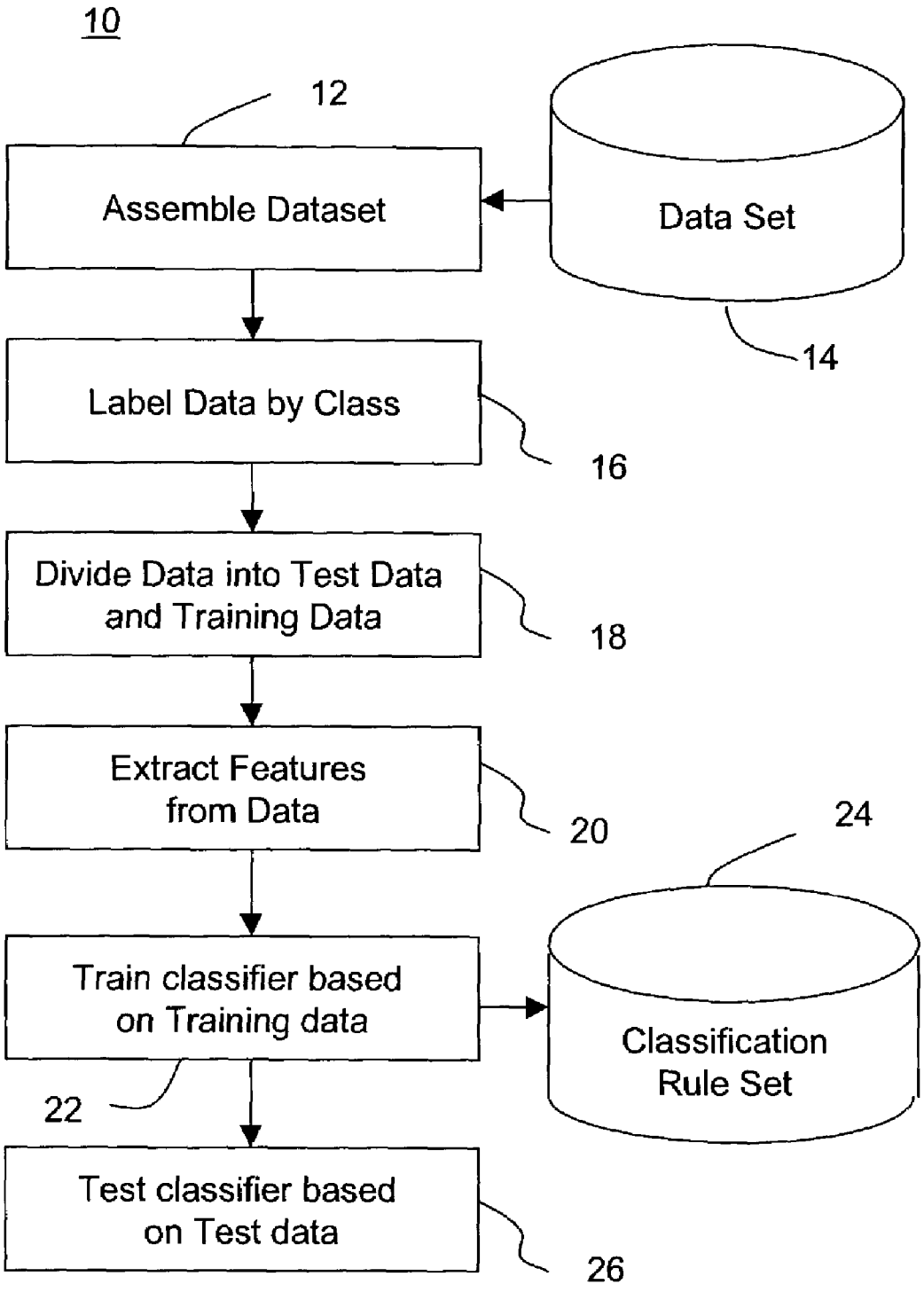


FIG. 1

```
646e 776f 2e73 0a0d 0024 0000 0000 0000
454e 3c0f 026c 0009 0000 0000 0302 0004
0400 2800 3924 0001 0000 0004 0004 0006
000c 0040 0060 021e 0238 0244 02f5 0000
0001 0004 0000 0802 0032 1304 0000 030a
```

FIG. 2

$$\neg advapi32 \wedge avicap32 \wedge \cdots \wedge winmm \wedge \neg wsock32$$

FIG. 3

$$advapi32.AdjustTokenPrivileges()$$
$$\wedge\ advapi32.GetFileSecurityA() \wedge \cdots$$
$$\wedge\ wsock32.recv() \wedge wsock32.send()$$

FIG. 4

$$advapi32 = 2 \wedge avicap32 = 10 \wedge \cdots$$
$$\wedge \quad winmm = 8 \wedge wsock32 = 2$$

FIG. 5

$$
\begin{aligned}
malicious &:= \neg user32.EndDialog() \wedge \\
&\quad kernel32.EnumCalendarInfoA() \\
malicious &:= \neg user32.LoadIconA() \wedge \\
&\quad \neg kernel32.GetTempPathA() \wedge \neg advapi32. \\
malicious &:= shell32.ExtractAssociatedIconA() \\
malicious &:= msvbvm. \\
Benign &:- otherwise
\end{aligned}
$$

FIG. 6

$$
\begin{aligned}
P(\text{" windows"}\backslash benign) &= 45/47 \\
P(\text{" windows"}\backslash malicious) &= 2/47 \\
P(\text{"*.COM"}\backslash benign) &= 1/12 \\
P(\text{"*.COM"}\backslash malicious) &= 11/12
\end{aligned}
$$

FIG. 7

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