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SAFRAN
Morpho

Data Classification using Python and R – Industry Use

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Introduction

1. Why is "data classification" needed ?
Today the world is data driven world … data classification and data mining is critical to understanding patterns and behavior. This enables data prediction and projection.

2. What is data classification ? … and Data mining ?
Data mining is typically done on abstract data think social networking data**. Data Classification** is typically done on known data.

At MDI, we manufacture complex, state of the art baggage scanning equipment. The many components of these EDS's (Explosive Detection System) produce a large amount of known data. We ***classify, process & predict*** this data to provide proactive maintenance

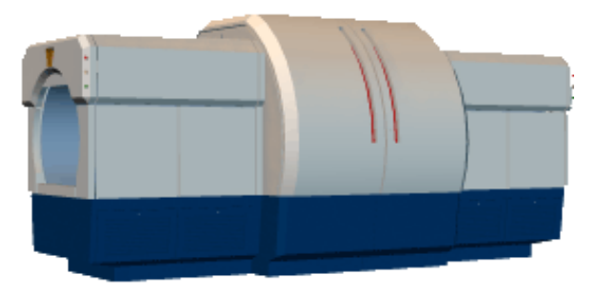


Figure 1. Explosive Detection System (EDS)

Process

- Collect data from the airport(s)
- Analyze large datasets daily and publish on a web dashboard
- Define critical parameters
- Use rules engine and knowledge base to create alerts
- Email alerts to relevant staff

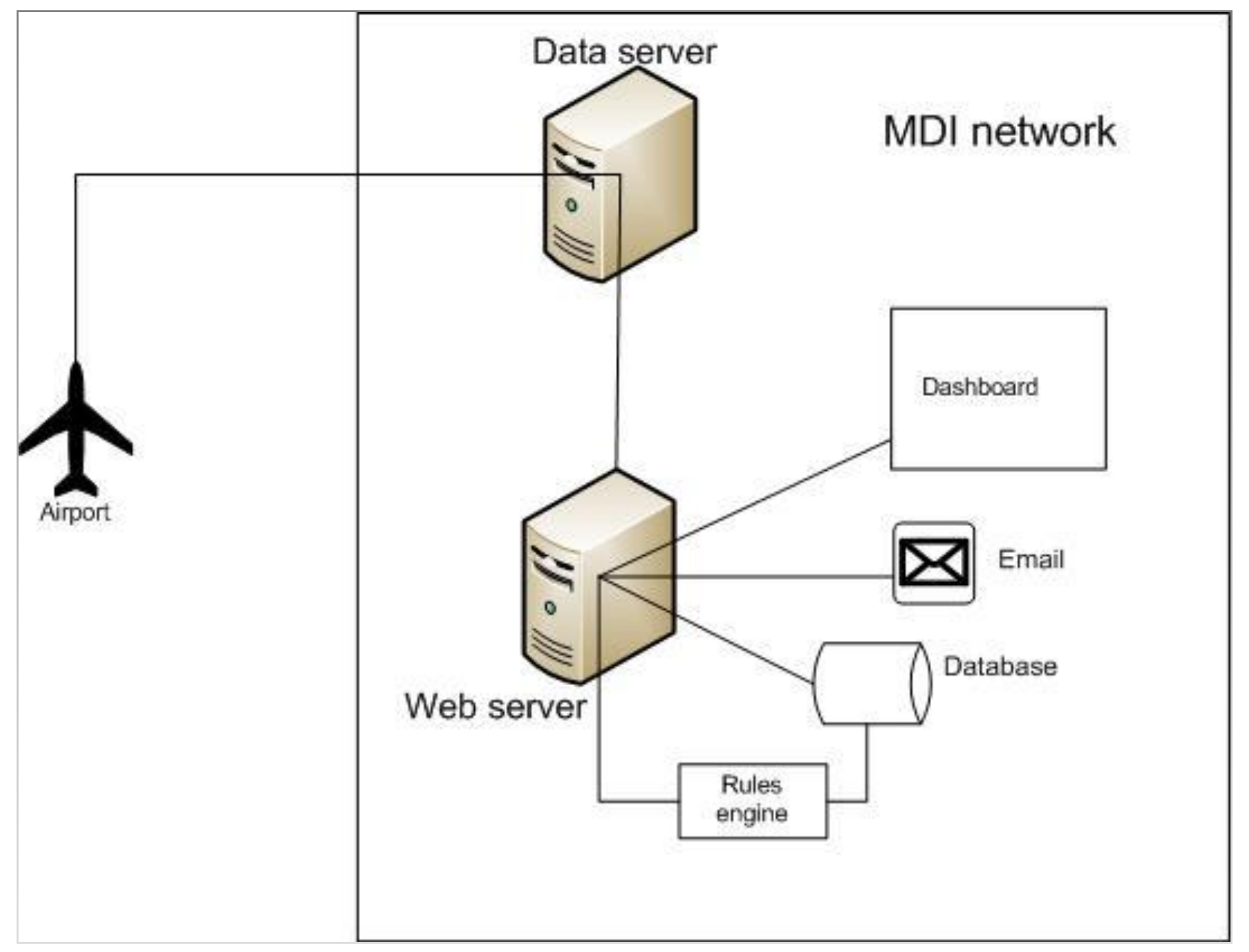


Figure 2. Top level design for the real time performance dashboard.

Technology

python powered   django   R   RPy

Decision Tree Learning
From Wikipedia, Decision Tree Learning used in statistics, data mining and machine learning, uses a decision tree as a predictive model which maps observations about an item to conclusions about the item's target value.
In data mining, a decision tree describes data but not decisions; rather the resulting classification tree can be an input for decision making.
http://en.wikipedia.org/wiki/Decision_tree_learning

Classification And Regression Tree (CART) model is used for "rules engine" here.

```
gData <-read.csv("enc1err.csv", sep=",", header=TRUE)
fit <- rpart(Result ~ err  + errf, method="class", data=gData)
```

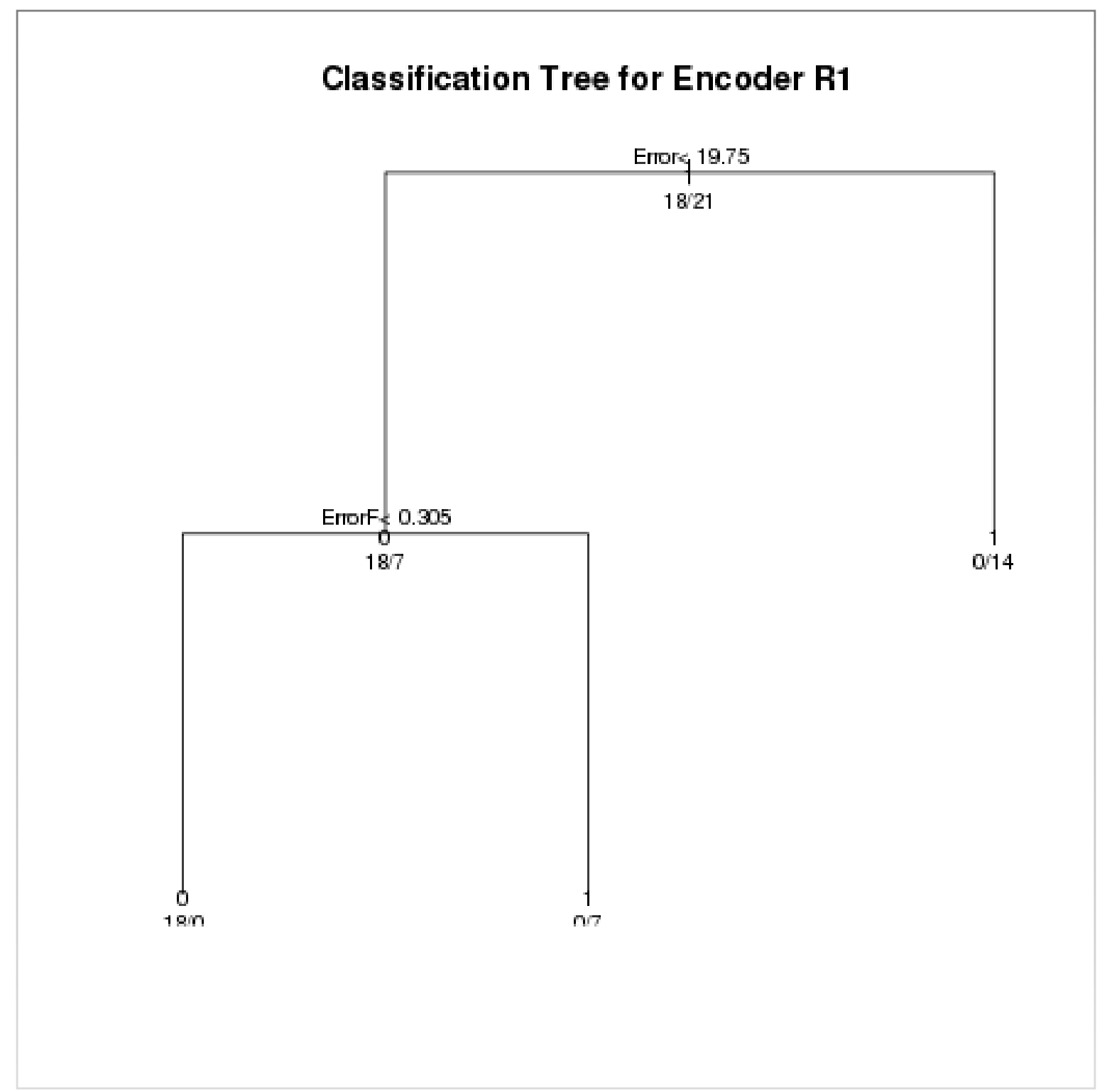


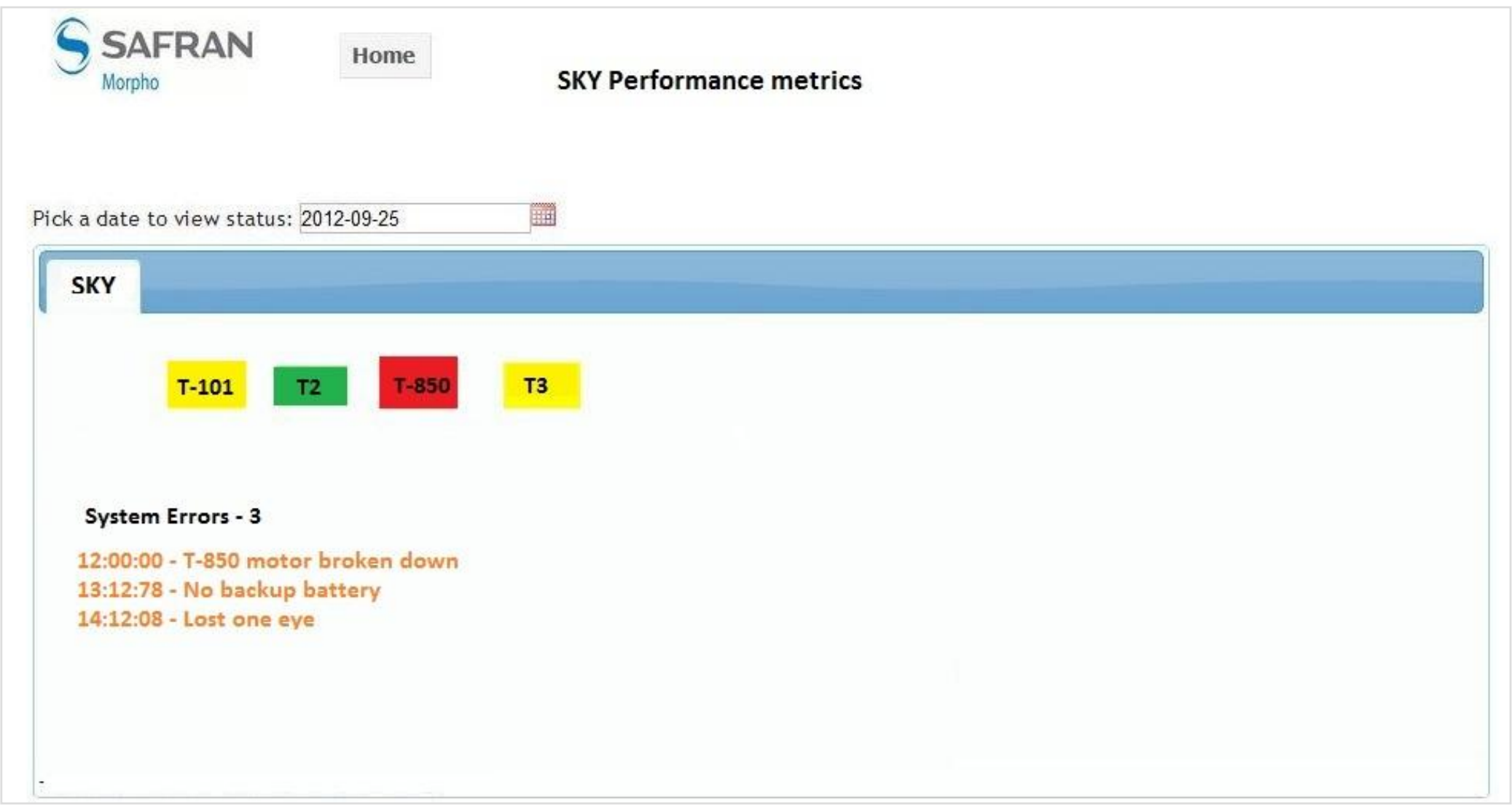
Figure 3. Decision Tree Classification for one of the key components in the MDI EDS.

R is a free software package for statistical computing and graphics. rpart is the package for producing CART models
To create an R decision tree:

- Get training samples
- 'Fit' data using rpart
- Score using validation data
- Predict test data
- Additional steps, pruning a tree etc.

Implementation

Color codes: Yellow = warning, Red = Error , Green = Normal



SKY Performance metrics

Pick a date to view status: 2012-09-25

SKY

T-101   T2   T-850   T3

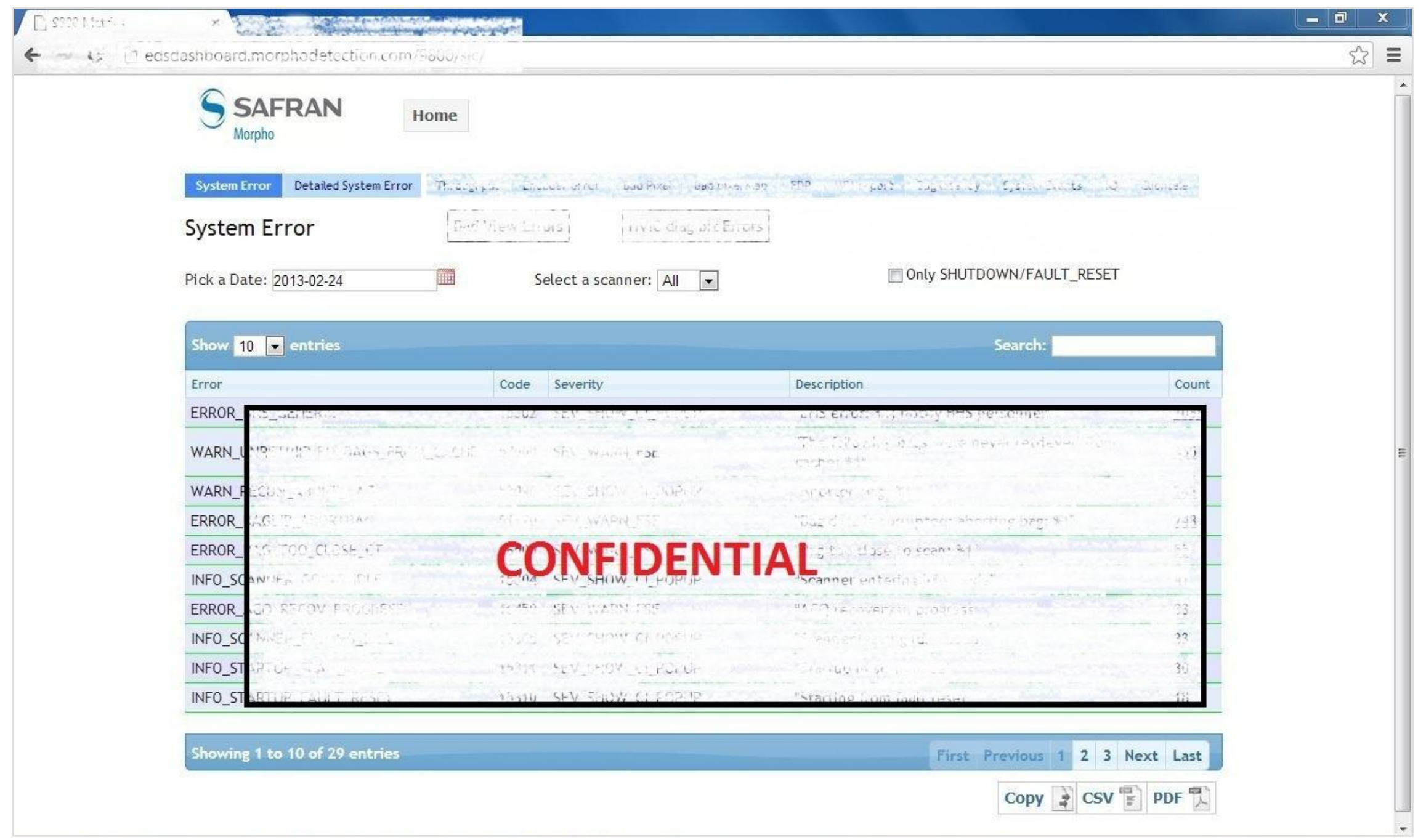
System Errors - 3
12:00:00 - T-850 motor broken down
13:12:78 - No backup battery
14:12:08 - Lost one eye

Figure 4. Example of what a status page looks like on the web based dashboard.

Sample Code

```
#rpy script to predict and score
import os
from config import ROOT_PATH
from rpy2 import robjects
from rpy2.robjects import r
rpart = r.library("rpart")
class Rules(object):
    #Create rules based on CART model
    def __init__(self):
        self.csvpath = os.path.join(ROOT_PATH, "/train/")
    def r1tree(self):
        #Fitting the tree based on training sample
        self.e1path = os.path.join(self.csvpath,
"e1err.csv")
        self.r1cmd = 'e1Data <-read.csv("%s", sep=",",
header=TRUE)'%(self.e1path)
        robjects.r(self.r1cmd)
        robjects.r('e1fit <- rpart(res ~ err + ef,
method="class", data=e1Data)')
     def r1val(self):
        #Validate and predict new data
        robjects.r('validationData <-
read.csv("/tmp/e1val.csv", sep=",",   header=TRUE)')
        robjects.r('test <- predict(e1fit,interval =
"prediction",newdata=validationData, type="vector")')
        self.scored = robjects.r('test')
        return self.scored
```

✓ Returns a score of 1 or 0 and classifies the data
✓ Data analysis can now be performed by applying rules on this classified data.



System Error

Pick a Date: 2013-02-24   Select a scanner: All   □ Only SHUTDOWN/FAULT_RESET

Show 10 entries   Search:

Error	Code	Severity	Description	Count
ERROR_	[illegible]	[illegible]	[illegible]	[illegible]
WARN_U	[illegible]	[illegible]	[illegible]	[illegible]
WARN_R	[illegible]	[illegible]	[illegible]	[illegible]
ERROR_	[illegible]	[illegible]	[illegible]	[illegible]
ERROR_	[illegible]	[illegible]	[illegible]	[illegible]
INFO_SC	[illegible]	[illegible]	[illegible]	[illegible]
ERROR_	[illegible]	[illegible]	[illegible]	[illegible]
INFO_SC	[illegible]	[illegible]	[illegible]	[illegible]
INFO_ST	[illegible]	[illegible]	[illegible]	[illegible]
INFO_ST	[illegible]	[illegible]	[illegible]	[illegible]

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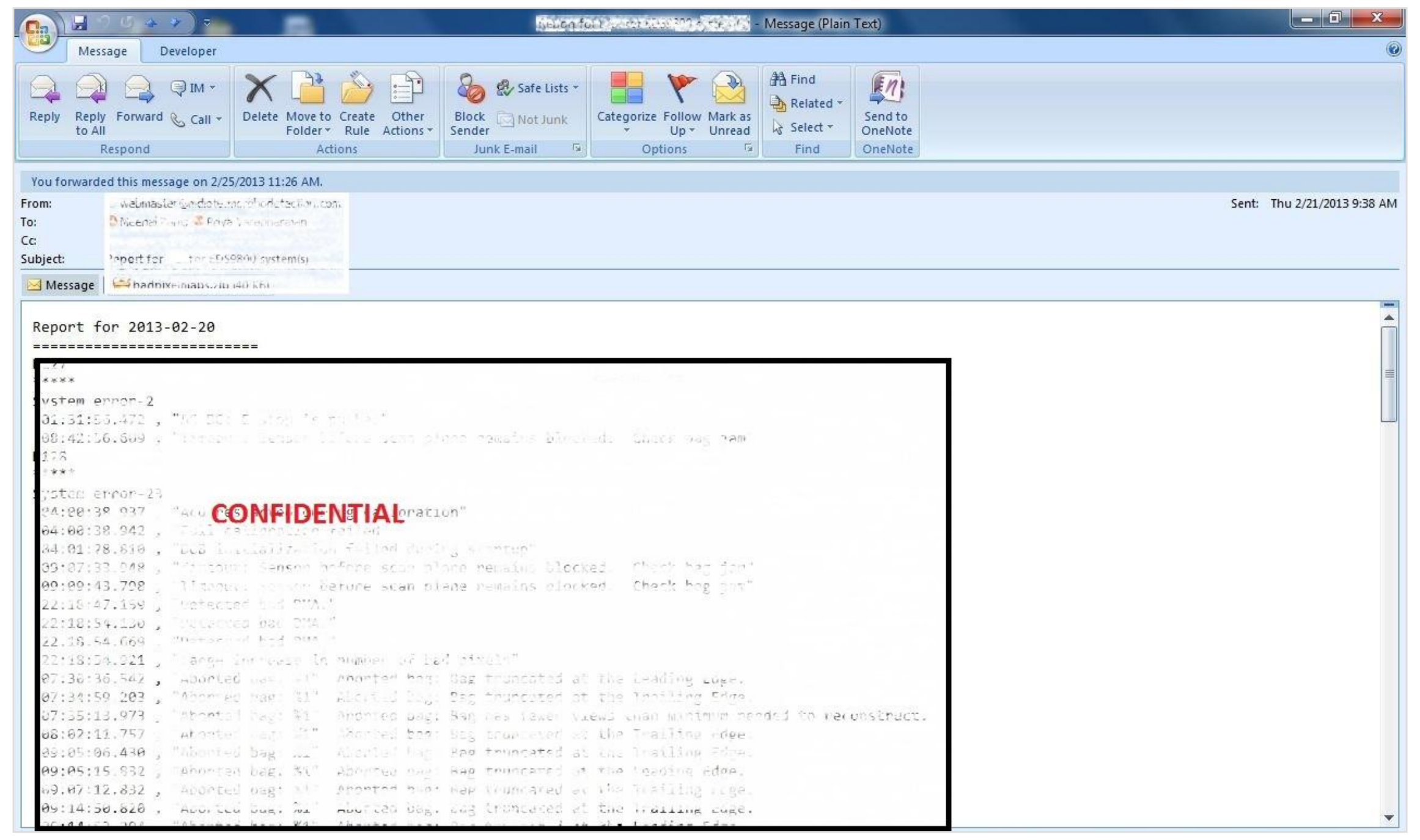
Showing 1 to 10 of 29 entries   First Previous 1 2 3 Next Last

Figure 5. Detailed reports example



You forwarded this message on 2/25/2013 11:26 AM.

From:
To:
Cc:
Subject:
Sent: Thu 2/21/2013 9:38 AM

```
Report for 2013-02-20
=========================
```

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Figure 6. Daily email to the maintenance support staff

Benefits

- Direct cost benefits due to reduction in downtime
- Can identify and troubleshoot issues faster
- Improves personnel efficiency
- Always available status and results
- Archived results to learn trends and patterns

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Questions and feedback

Please contact *mpant@morphodetection.com*