



User Manual

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Medical Measurement Quality  
Application

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## 1 Introduction

This document describes the demo implementation of the "Medical Measurement Quality Application", hereafter mentioned as "application". Home healthcare services are emerging as a new frontier in healthcare practices. Data reliability, however, is crucial for the acceptance of these new services. The developed application is a semi-automated system to evaluate the quality of medical measurements taken by patients. The system relies on data qualifiers to evaluate various quality aspects of measurements. The overall quality of measurements is determined on the basis of these qualifiers enhanced with a troubleshooting mechanism. Namely, the troubleshooting mechanism aims to guide healthcare professionals in the investigation of the root causes of low quality values. A more detailed description of the system is presented in [2].

## 2 Implementation

To facilitate the portability and usability of the application the implementation was based on Web technologies. In particular, the development of the application was based on the Apache web server and MySQL RDBMS. The server-side programming of the application was done with the use of the PHP programming language. For the client-side part, several web technologies such as HTML, Javascript and CSS were used.

The demo application is available at <http://security1.win.tue.nl/demo/>.

Note: To demonstrate our approach we use the system designed by Roessingh Research and Development for the gathering of activity data [1] as an illustrative example.

## 3 Demo Presentation

In this section we present the basic features implemented in the demo application.

### 3.1 User Application

The evaluation of the overall quality of a measurement is based on several different data qualifiers. However, users can be easily overloaded with too much additional information. To this end, the main page of the application displays the measurement in a compact view mode, by default (Fig. 1). Each measurement is presented as a row of the table, along with the information about the patient name, the name and the overall quality of the measurement. The overall quality has three states namely: High (Green), Medium (Yellow) and Low (Red). However, if the interpretation of the quality is ambiguous, the troubleshooting button is displayed. By clicking the troubleshooting button the respective mechanism is triggered.

Information

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Measurements

Management

Show 10 entries Search:

Name	Type	Date	Value	Total Quality
Sammy Soe	Activity	2013-05-11	1619	High
Jackie Joe	Activity	2013-01-20	1502	Troubleshoot
Xerxes Xoe	Activity	2013-04-13	1456	Troubleshoot
John Doe	Activity	2013-04-01	1416	Troubleshoot
Quintin Qoe	Activity	2013-01-27	1387	Medium [f]
Quintin Qoe	Activity	2013-05-15	1332	Troubleshoot
Frank Foo	Activity	2012-11-02	1247	Troubleshoot
Sammy Soe	Activity	2012-12-11	1067	High
Carla Coe	Activity	2013-02-23	1057	Medium [f]
John Doe	Activity	2013-04-01	1050	Low [f]

Showing 1 to 10 of 22 entries

Show / Hide Qualifiers

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Figure 1: Main Page - Compact View

In some cases, the user of the system might want to have a deeper insight on the different quality aspects of a measurement. To facilitate this need the expanded view mode is offered (Fig. 2) by the application. In this mode, the values of qualifiers are displayed.

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Measurements

Management

Show 10 entries Search:

Name	Type	Date	Value	Q1.A	Q1.B	Q3.C	Q3.D	Q5	Total Quality
Sammy Soe	Activity	2013-05-11	1619	High	High	High	High	U	High
Jackie Joe	Activity	2013-01-20	1502	High	Low	Medium	High	U	Troubleshoot
Xerxes Xoe	Activity	2013-04-13	1456	High	Low	High	High	U	Troubleshoot
John Doe	Activity	2013-04-01	1416	High	Low	High	High	U	Troubleshoot
Quintin Qoe	Activity	2013-01-27	1387	High	High	Medium	High	U	Medium [f]
Quintin Qoe	Activity	2013-05-15	1332	High	Low	High	High	U	Troubleshoot
Frank Foo	Activity	2012-11-02	1247	High	Low	High	High	U	Troubleshoot
Sammy Soe	Activity	2012-12-11	1067	High	High	High	High	U	High
Carla Coe	Activity	2013-02-23	1057	High	High	Medium	High	U	Medium [f]
John Doe	Activity	2013-04-01	1050	High	Medium	High	Low	U	Low [f]

Showing 1 to 10 of 22 entries

Show / Hide Qualifiers

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Figure 2: Main Page - Expanded View

One of the core modules of the application is the troubleshooting and feedback

mechanism. On the one hand, the troubleshooting mechanism provides an interactive solution to find the root causes of low quality. Specifically, the user by clicking the **Troubleshooting** button (Fig. 2), is requested to answer a series of questions in order to assist the evaluation procedure. We represent the troubleshooting mechanism as a set of workflows, as shown in Fig. 3. On the other hand, the feedback mechanism is used to display an advisory message to the patient, based on the root cause of low quality. Hence, the patients are helped to improve their future measurements. The feedback message is displayed by clicking on the *[f]* button in the *OverallQuality* column (Fig. 2). A sample troubleshooting question along with a sample feedback message are shown in Fig. 4.

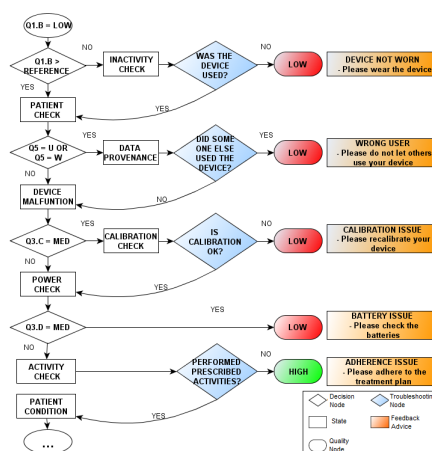


Figure 3: Sample Troubleshooting workflow

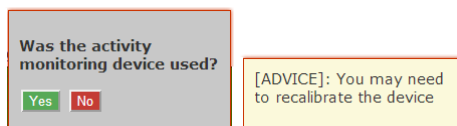


Figure 4: Sample Troubleshooting question and Feedback Message

### 3.2 Management

The Management interface offers to the administrator the ability to manage the different data qualifiers used in the system. In the main page (Fig. 5), every data qualifier is displayed along with its properties (e.g., Type of Measurement, Category, Function, etc.). The application currently supports only activity measurements. Moreover, a qualifier must belong in one of the three categories supported by the system [2]. Via the management system, the administrator is able to add, edit or delete a qualifier (Fig. 6).

View Records											
ID	Name	Type	Function	Threshold	Category	Display Name	Tooltip	Feedback	Troubleshooting		
1	q1a	activity	range	50,2000	2	Q1.A	Range Check		X	Edit	Delete
2	q1b	activity	distance	10,20	2	Q1.B	Expected Value		✓	Edit	Delete
3	q3c	activity	timedist	5,18	1	Q3.C	Device Calibration	Please recalibrate the device, You may need to recalibrate the device	-	Edit	Delete
4	q3d	activity	binary	0	1	Q3.D	Power Supply	Please change the batteries, Please check the batteries	-	Edit	Delete
5	q5	activity	auth	0	3	Q5	Data Authenticity		-	Edit	Delete

[Add New Record](#)  
[Demo](#) [Logout](#)

Figure 5: Management Main Page

One key aspect of defining a data qualifier, is the evaluation function used. Currently, there are four different generic functions supported, namely: Range, Distance, Time Distance and Binary. Moreover, certain qualifiers might need more fine-grained functions with respect to their nature. To this end, the application currently supports one qualifier specific function, the the Authentication function, used to evaluate the different user-authentication mechanisms employed by the system. Finally, if a qualifier belongs in the second category, the administrator is able to provide the corresponding troubleshooting scenario and feedback messages.

### Add Record

Name:

Type:

Function:

Threshold:

Category:

Display Name:

Tooltip:

Feedback:

### Edit Record

ID: 2

Name:

Type:

Function:

Threshold:

Category:

Display Name:

Tooltip:

Feedback:

Troubleshooting:

Figure 6: Add / Edit a qualifier

## 4 Acknowledgements

We thank colleagues at Roessingh R&D for useful discussions. This work is funded by the Dutch program COMMIT through the TheCS project.

## References

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- [2] S. Vavilis, M. Petkovic, and N. Zannone. Data reliability in home healthcare services. In *Proceedings of the 26th IEEE International Symposium on Computer-Based Medical Systems (CBMS 2013)*. IEEE, 2013.