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A Smart Approach on Collecting Working Condition Data from Home Appliances under the Field Test

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Abstract— This study presents management of the data that are taken from the home appliances which are in the field test process. Field test process means collecting the data from the device by sensors, the measurement from environment, then evaluation of this information. This information depends on climate, altitude, user profile etc. Major application area of this study is home appliances sets and their domestic field test process. Also, this smart approach can be applied to any system including any electrical equipment in smart grid. Only 2 different requirements should be covered. (i) Device Under Test (DUT) should work with the specialized test box to send working condition data and environmental measurements. (ii) GSM network should be alive in field test location. This study shows a new smart approach which relies on sending the field test data and environmental conditions over the GSM. The selection reason of GSM communication protocol in this study is the coverage percentage of this protocol is wider than others.

Index Terms—Smart Approach for Condition Monitoring, Field Test, Test Box, Device under Test.

I. INTRODUCTION

Field Test is one of the most important point to learn the working conditions of products with real user profiles. Because this field data is necessary to inform R&D department for the occurred problems and the bugs, and to solve these problems and bugs remotely before the main delivery of the products.

Currently, the field test of the products is one of the most important subject to develop more stable and high quality products. After sales controls of product is as important as the test process in the development phases. Both of during development phase tests and after sales controls in the field increase the quality and performance results of the product.

Until now, customary methods are being used during white goods field test process. Mainly, customary field test covers taking the product from company, moving to test point, testing by operator, making the bug lists that contain observed bugs and saving them, bringing the product at the end of the test with the bug list, solving the problems then verifying them with new SW version that contain the solutions, in the same test point. However, this method takes a long time, is too expensive and is experienced based.

Fig. 1 shows Joiner Plus [1] general connection view. That is possible to take some information from device by GSM, except user profile information and environmental measurements data.

Figure 1. Joiner Plus

Also in our innovative approach, SIM card is located in designed test box which has internal GSM module. This means each field test setup has its own data line, and its own special key for

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security issue. So, the field test data can be inspected separately from all devices.

In consumer industry, there are other solutions to take data from the devices. Most of them use Wi-Fi connection [2-5]. This means, the test point should have internet connection at all. This is an obligation. Also, in the literature can be find another related some studies including energy consumption models for household consumers [6] and smart metering based energy tariff schemes [7].

Our study is related to management of the data that are taken from the home appliances under the field test process. With this system, the working conditions of white goods such as water temperature, door open/close count, motor RPM, power parameters of the system etc., and environmental conditions including vibration level of tested device, ambient temperature, external surface temperature of the product, humidity etc. can be sent via GSM network to the cloud server instantly. The measured parameters can be monitored for analyzing at any time.

II. THE DESIGNED SYSTEM ARCHITECTURE

A. User Interface

The stored data at cloud server can be controlled, listed, plotted as a graph, and can be input for other systems. All these functions can be realized by user interface of the system shown in Fig.2.

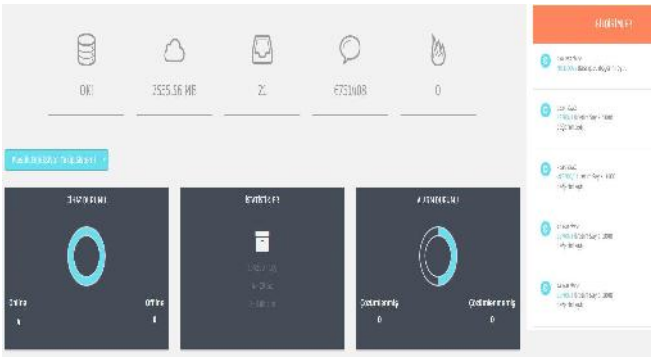

Figure 2. Designed User Interface

In Fig.2, the state of the system, online and offline device counts, urgent notifications, system call-messages, incoming data size can be monitored by the user interface. At the right-hand size, all instant notifications are listed. At the middle of the screen, by clicking device state section, all device list can be viewed.

It is available to arrange required attributes of the selected device by its Device ID as shown in Figure 3.

Figure 3. Device List Screen

B. Principle of the System

As shown in Fig.4, the data from different white goods can be taken by sensors and connected cables from different white goods with the Test-Box which is designed and fabricated by Vestel Electronics Company R&D department, and the values can be sent via GSM to Cloud Server directly. Then these huge data can be evaluated, listed in tables, stored or processed whenever it is needed.

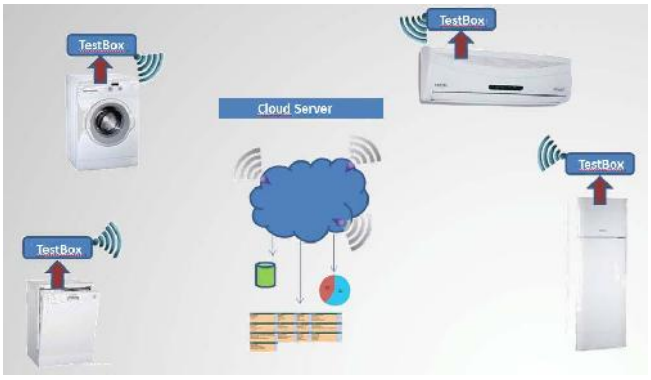

Figure 4. General System Overview

The method used in this study to collect the data from the devices does not need to internet connection. Instead of this, we have an internal GSM module in the developed test-box. Because the GSM map covers more point then internet map of Turkey.

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Generally, the block diagram of the developed test-box is shown in Fig.5. The system mainly consists of digital or analogy input/output, isolated AC inputs, temperature module (both of external and internal), energy measurement module (current, voltage, power factor etc.), GSM module (to realize the data communication) and a UART module.

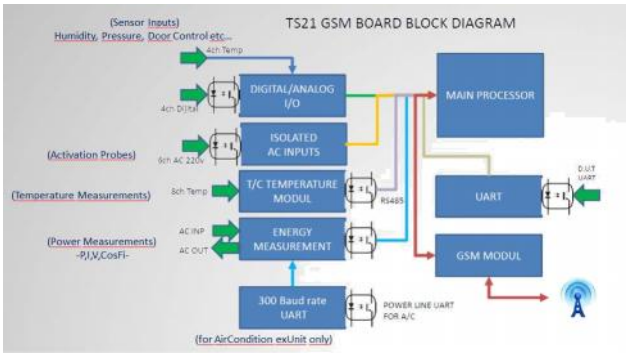

Figure 5. System Block Diagram

C. Communication Protocol

Fig.6 shows that there is one wire connection between device under test and the test box. By this connection, some data can be taken from DUT.

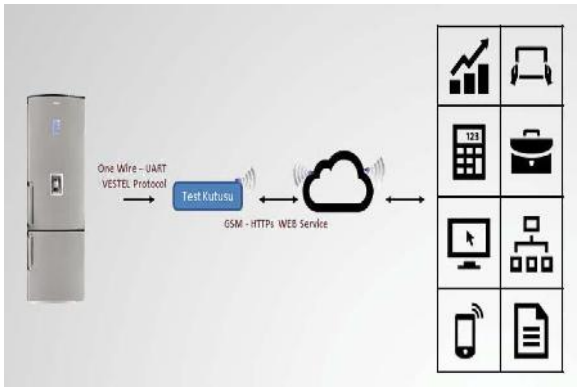

Figure 6. One Wire Connection

Data from the devices under test are arranged to the cloud system separately. Collected data are listed in a table form at server side. Fig.6 shows the data table. At server side, it is possible the track and control the devices under test. All data that belongs to the device can be listed and viewed.

As an example, Voltage and Current values that belong to *Pano1* which is the given name for the test box that is located in one of the field test point is located in Fig.7.

By using user interface all data can be plot as a graph at any time. In Fig.8, Voltage and Current values which are between desired dates are plotted.

Figure 7. Sensor Data

Figure 8. Plotted Graph

III. CONCLUSION

This study shows a smart approach for field test process including easy to remote control and tracking for the devices, energy monitoring at high safety level.

By this approach, it is possible to solve remotely the bugs which occurred depending on the environmental conditions and usage profiles. During field test process, if a critical condition occurs (for instance, the temperature of device surface is increasing) the device electricity can be cut off. This means, some alarm condition definitions related to safety issues can be set separately.

As a future work, when a critical issue is occurred at any device, this device can inform the other ones.

Hence, it can be easy to understand this issue is sample dependent or it is a failure of that product series. Additionally, this approach can be implemented in distributed factories to follow energy consumptions. Also, this is useful for tracking and monitoring the energy consumptions in a region.

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