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Research Article

Designing a Remote Monitoring and Security System for Broadcast Transmitters

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ABSTRACT

Remote monitoring systems are vital for many systems. Especially in the broadcasting industry, it is critical to keep the broadcasts running 24/7 uninterrupted. It is another challenge to be aware of the interruptions in terrestrial broadcasts on the country's geography and to intervene as soon as possible. For this reason, it is aimed to monitor TRT (Turkish Radio Television Co.) FM and TV transmitters and to gather information about their malfunctions and following station security warning. With the developed system, the follow-up of those responsible has been facilitated, and the response times have been shortened and with the help of motion-sensitive cameras, the security level was increased by taking pictures in the OMC (Operation Monitoring Center). In addition, it is recommended to have appropriate spare materials by ensuring that the teams have information about the type of failure.

Keywords: Remote Monitoring, FM TV Transmitter, Automation, Internet of Things, Data Management.

Yayın Vericileri için Uzaktan İzleme ve Güvenlik Sistemi Tasarlanması

ÖZET

Uzaktan izleme sistemleri birçok sistem için hayati öneme sahiptir. Özellikle yayıncılık sektöründe yayınların 7/24 kesintisiz devam etmesi kritik önem taşımaktadır. Ülke coğrafyasında karasal yayınlardaki kesintilerden haberdar olmak ve en kısa sürede müdahale edebilmek de bir başka zorluktur. Bu nedenle TRT FM ve TV vericilerinin izlenmesi, arızaları hakkında bilgi toplanması ve istasyon güvenlik uyarılarının takip edilmesi amaçlanmaktadır. Geliştirilen sistem ile sorumluların takibi kolaylaştırılarak, müdahale süreleri kısaltıldı ve harekete duyarlı kameralar yardımıyla OMC'de (Operasyon İzleme Merkezi) fotoğraf çekilerek güvenlik seviyesi artırılmıştır. Ayrıca ekiplerin arızanın türü hakkında bilgi sahibi olması sağlanarak uygun yedek malzemelerin bulundurulması sağlanmaktadır.

Anahtar Kelimeler: *Uzaktan İzleme, FM TV Vericisi, Otomasyon, Nesnelerin İnterneti, Veri Yönetimi*

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I. INTRODUCTION

Especially IT systems, energy distribution networks, patient status controls are frequently encountered issues in terms of remote monitoring. This data is critical for decision support units. In addition to monitoring the weather conditions as another area recently, it has been used to warn the public in disasters such as tsunamis in the far east.
In terms of radio and TV broadcasters; To create a large coverage area, hundreds or even thousands of transmitters must be able to transmit broadcasts without interruption. The uninterruptedness of radio and television transmitters, is very important in terms of reputation. In addition, interruptions can cause financial losses. Advertising companies will not want to advertise to a channel in this situation.
Today, TRT broadcasts with 14 television channels, 14 radio channels and thousands of transmitters throughout the country [1]. The relevant department of the institution needed a system to monitor the systems. For this reason, a system has been designed and advised for the transmitters can be tracked instantly.

II. MATERIAL AND METHOD

The purpose of remote monitoring systems is to collect data instantly or periodically from the people or systems to be followed, activating the necessary decision mechanisms. It is ensured that the data in critically important systems are instantly delivered to the center and appropriate actions are taken. Remote monitoring systems are gaining much more importance especially today. Recently, especially in the health sector , the follow-up of patient data [2], [3], the follow-up of the processes of the products in the supply chain, the follow-up of energy systems have been the main areas of interest. In particular, monitoring of weather conditions has been used for a long time. Tsunami warning [4], tides [5] or weather [6] conditions are some of them. The widespread use of digital data transfer processes has accelerated the development in these matters. Smart cars [7], trains [8] and traffic control systems [9] have also started to take their place in smart city applications. Even end users have started to follow it by installing a mind tracking system in their homes [10].
Broadcasting institutions perform terrestrial coverage with radio and television transmitters of various powers to provide coverage. With the spread of satellite broadcasts, a slight decrease is observed. Yet one transmitter is still broadcasting. In this framework, a system has been developed to be instantly informed in case of malfunctions in transmitters. The transmitter site remote monitoring system setup diagram is shown in figure 1. While there is one GSM modem at each station, a separate data reader card is used for each transmitter.

The proposed system consists of 3 parts.

- data collection unit,
- transmission unit,
- decision unit.

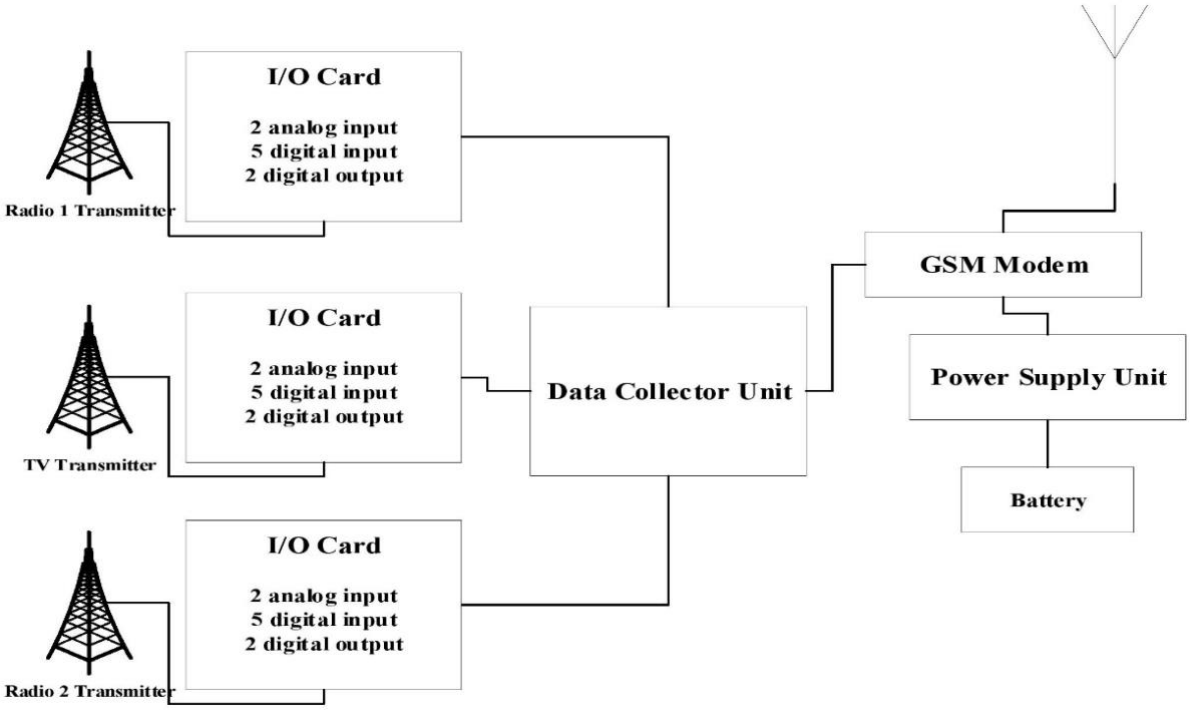

Figure 1. Transmitter Site Remote Monitoring System Setup Diagram

III. DATA COLLECTION UNIT

This unit is especially designed to collect meaningful data from different models and brands of transmitter systems at the same point. The unit has 9 I/O terminals. It has 2 analog and 5 digital inputs and motion detection cameras. It is also designed to have 2 output points that can be triggered by commands sent from the center (Figure 2).

In addition, with the help of the motion sensor, the photos of the people entering the station were taken and sent to the center. Analog inputs offer the opportunity to be adjusted according to the desired input in the range of 0-5 V. Since the outgoing and reflected power values are the most critical data for the transmitter systems, they are used for this purpose. By measuring the values at these outputs in each transmitter, it is possible to enter them as reference values in the central software. In this way, flexible use in different model transmitters is provided.

Figure 2. I/O Ports

Various information such as temperature failure, amplifier failure, generator failure, audio failure (Figure 3) information were obtained from the fault information given by the transmitter within the analog/digital inputs. If the door is opened or motion is detected, a snapshot is sent to the OMC center and a warning is sent.

Figure 3. L/R Audio inputs

With the output data, the entire system is reset. It is known that resetting the transmitters in some cases is the solution to many problems. Among possible GSM line problems, the modem was reset during the day to prevent possible connection problems.
Microchip 16F877 [11] chipset is used in the central control unit of the data unit. It is advantageous that the chip has input and output ports in accordance with the designed infrastructure. The general I/O ports of the chip are shown in figure 4.

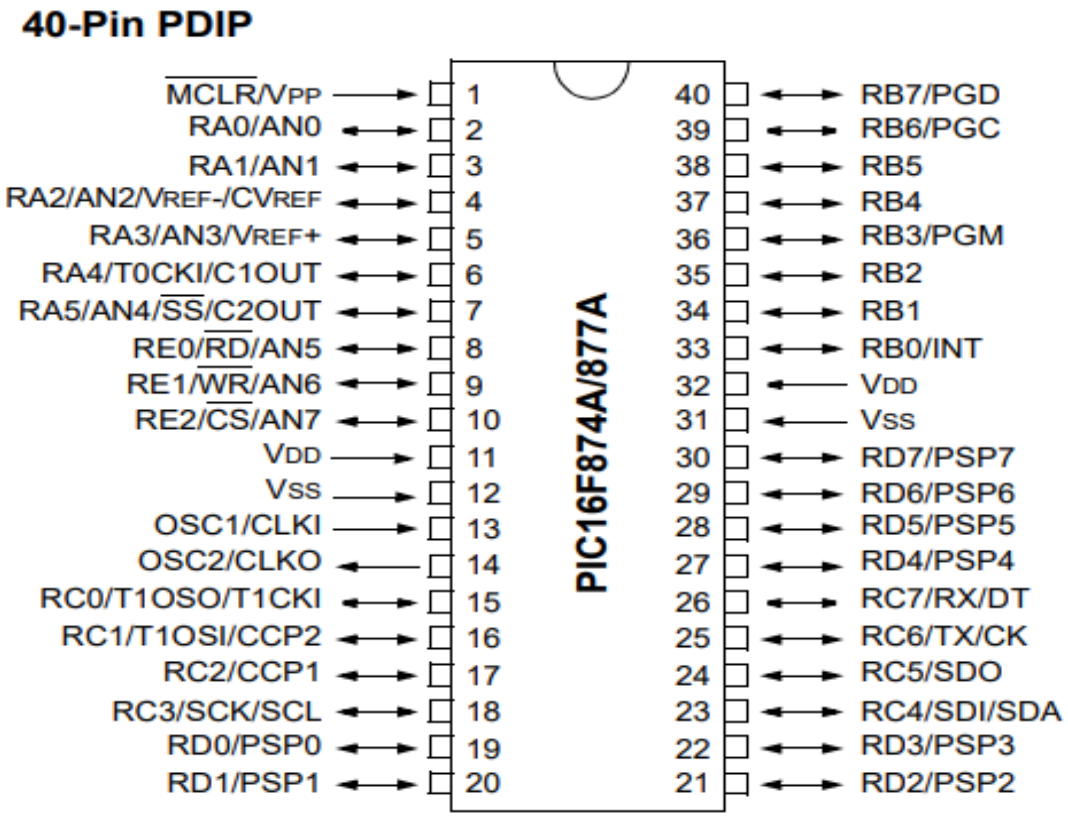

Figure 4. Data control unit chip set I/O port

IV. Transmission Unit

A GSM modem was used to transfer the collected data to central servers. A special data VPN infrastructure has been created to be affected by attacks. It is realized by establishing a TCP/IP connection to the data to the IP address and port address set in the modems. Table I shows GSM modem setting parameter. The application located on the central server makes sense of the data coming from each connection and saves it to the database.

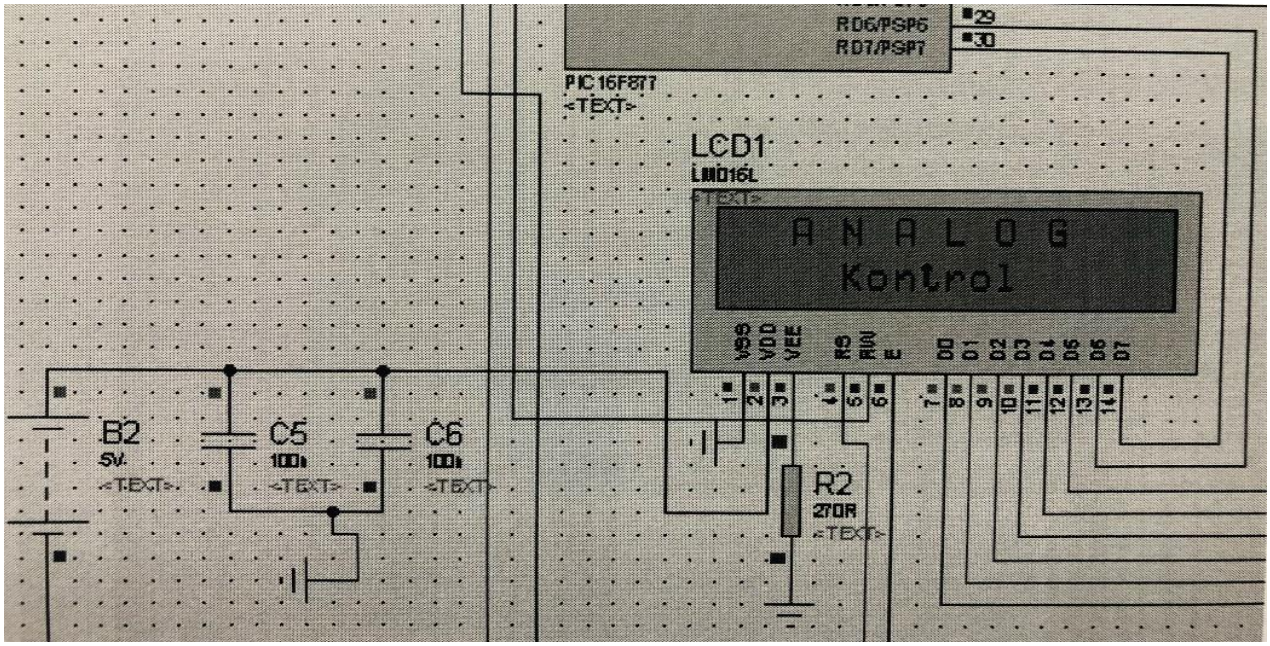

Figure 5. Proteus simulation for I/O control

The design of the project was drawn in Proteus [12] and the tests were carried out with the help of this program. Informative warnings are shown on the LCD screen during the controls. (Figure 5).

Table 1. GSM Modem Setting Parameter

Modem Settings

Input	Parameter
Pincode	1234
Protocol	IP
APN	trt
USERID	remote
PASSW	xxxx
SERVERADR	10.0.1.222
Remote Port	6074
SMSCENTERNO	+905xxyyzz
MAIL LOGIN	loginname
MAIL PASSW	password
SMTP ADDRESS	Smtp.xxx.yy
MAIL FROM	remote@xxx.yy
MAIL TO	to@xxx.yy

Necessary setups are made on the GSM modem with the help of AT commands [13]. When requested or in case of an internet problem, the data is sent to the center uninterruptedly via SMS. With the mail server integration, the possibility of warning the relevant personnel in an alternative way has been added (Table 1).

V. Decision Unit and Web Portal

The structure designed for the remote control system of the system is shown in figure 6. Two different server application developed, one of them is a web application (Figure 7) and second ones data Collector / parser. MS SQL was used as database server.

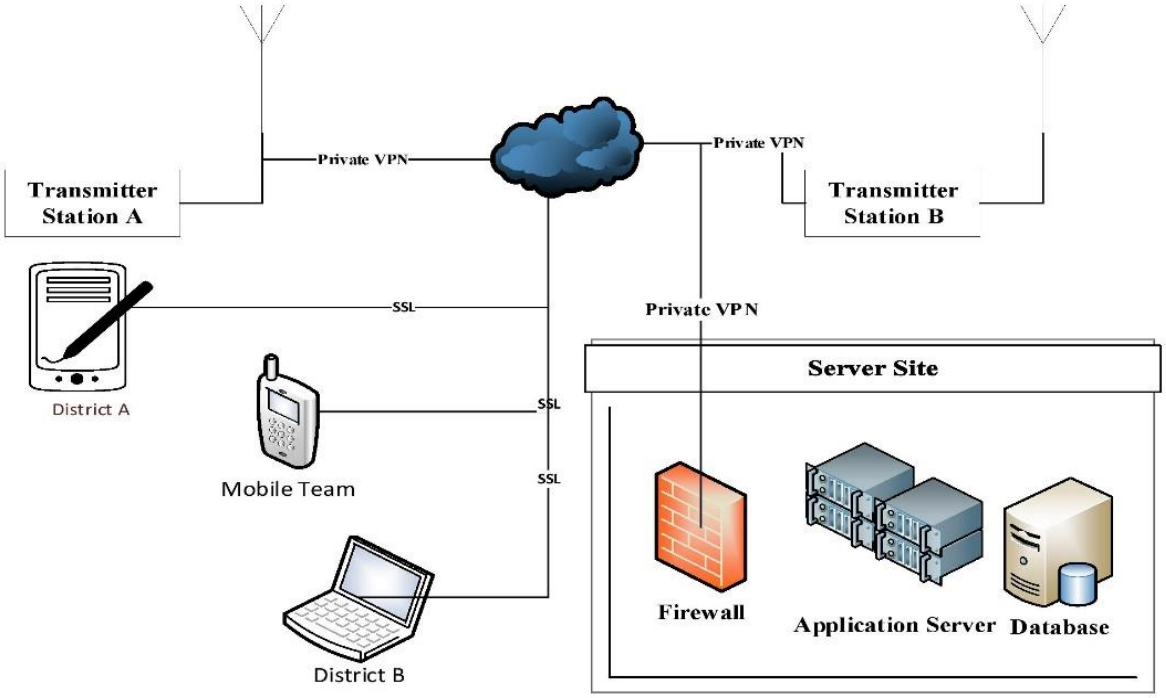

Figure 6. General system setup diagram

Figure 7. Remote Monitoring and Management System WEB application portal & Operations module

After adding the zone admins, each zone can be able to manage the information of the stations in its area of responsibility. Admins at the center have the opportunity to monitor and manage all region information (Figure 8).

Figure 8. Zone admin management module

A transmitter station can have different FM/TV transmitters. For this reason, only the I/O unit was connected to each transmitter, and all collected data was transmitted to the center with the help of a single modem at the central assembly point. In this way, cost advantage is provided by providing the need for only one modem at each station (Figure 9). GPRS ID shows central unit, Terminal No used for transmitters' identification. The necessary definitions for each unit were entered into the central script, thus making the data meaningful.

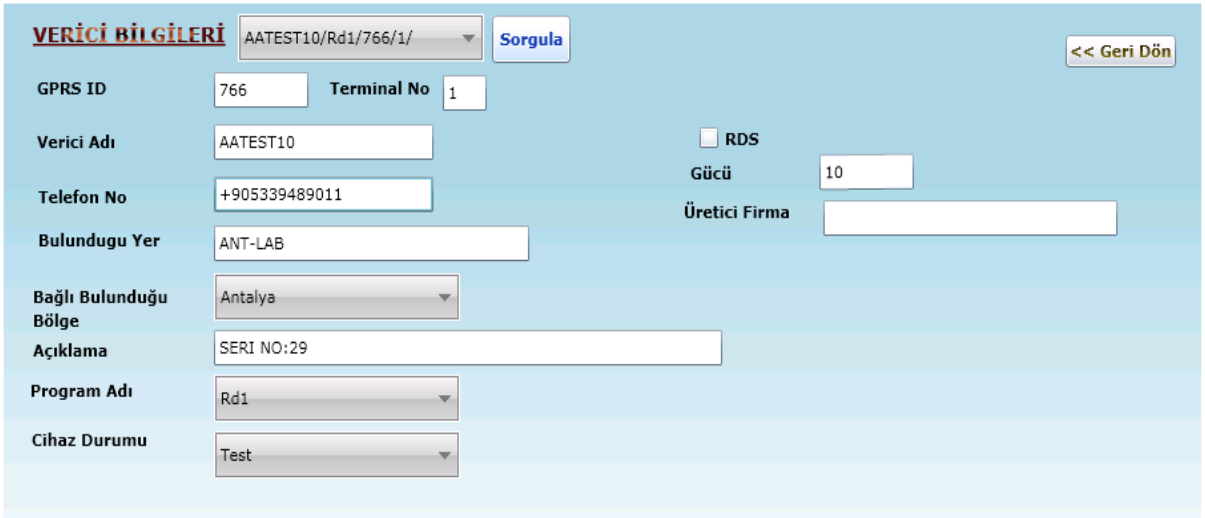

Figure 9. Center Server Apps; Data Collector and Data Parser Applications

The possibility of adjusting the parameter setting of the transmitter is provided (Figure 10). This ensures that the system works in harmony with devices of different models and powers, and easy and remote management of the assembly is ensured. It is possible to easily install the same device in TV / Radio, etc. devices.

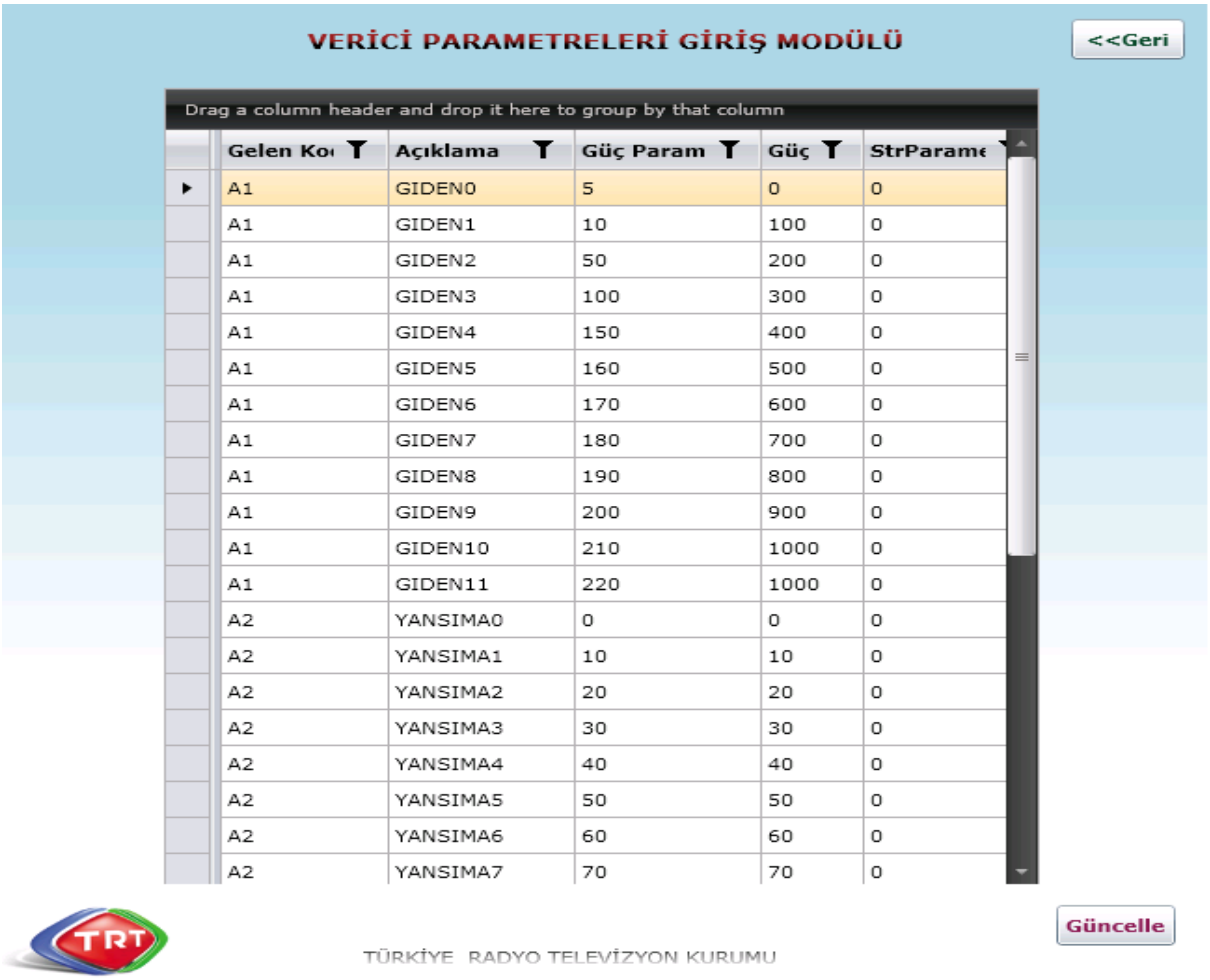

Figure 10. Transmitter parameters module

An application that accepts incoming connections and receives data on the central server has been developed. This application interprets the data from different transmitters according to the set values (Figure 11).

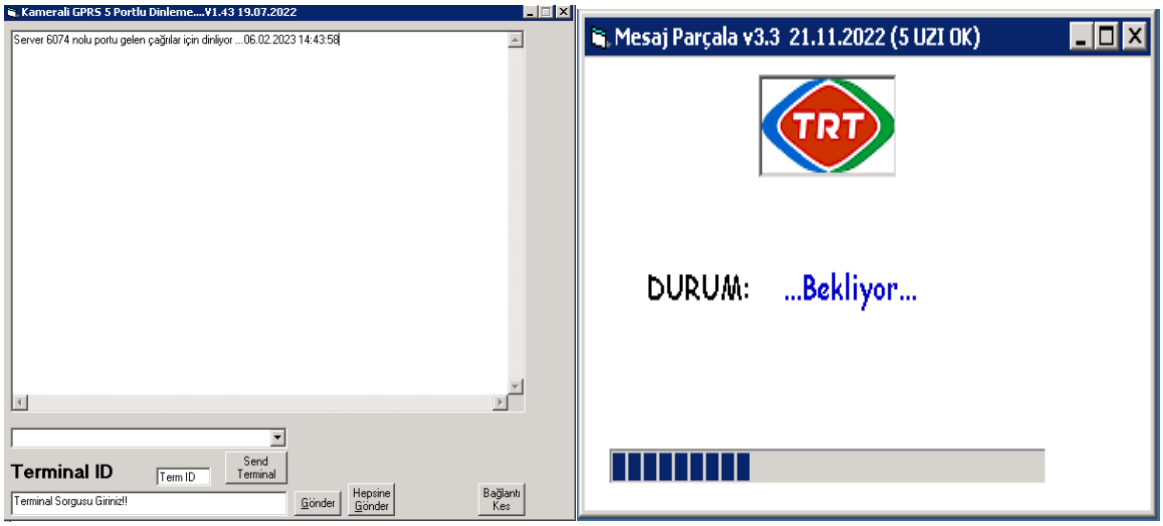

Figure 11. Central server apps; Data collector and Data parser applications

It is also provided to enter the coordinate information of the transmitters (Figure 12).

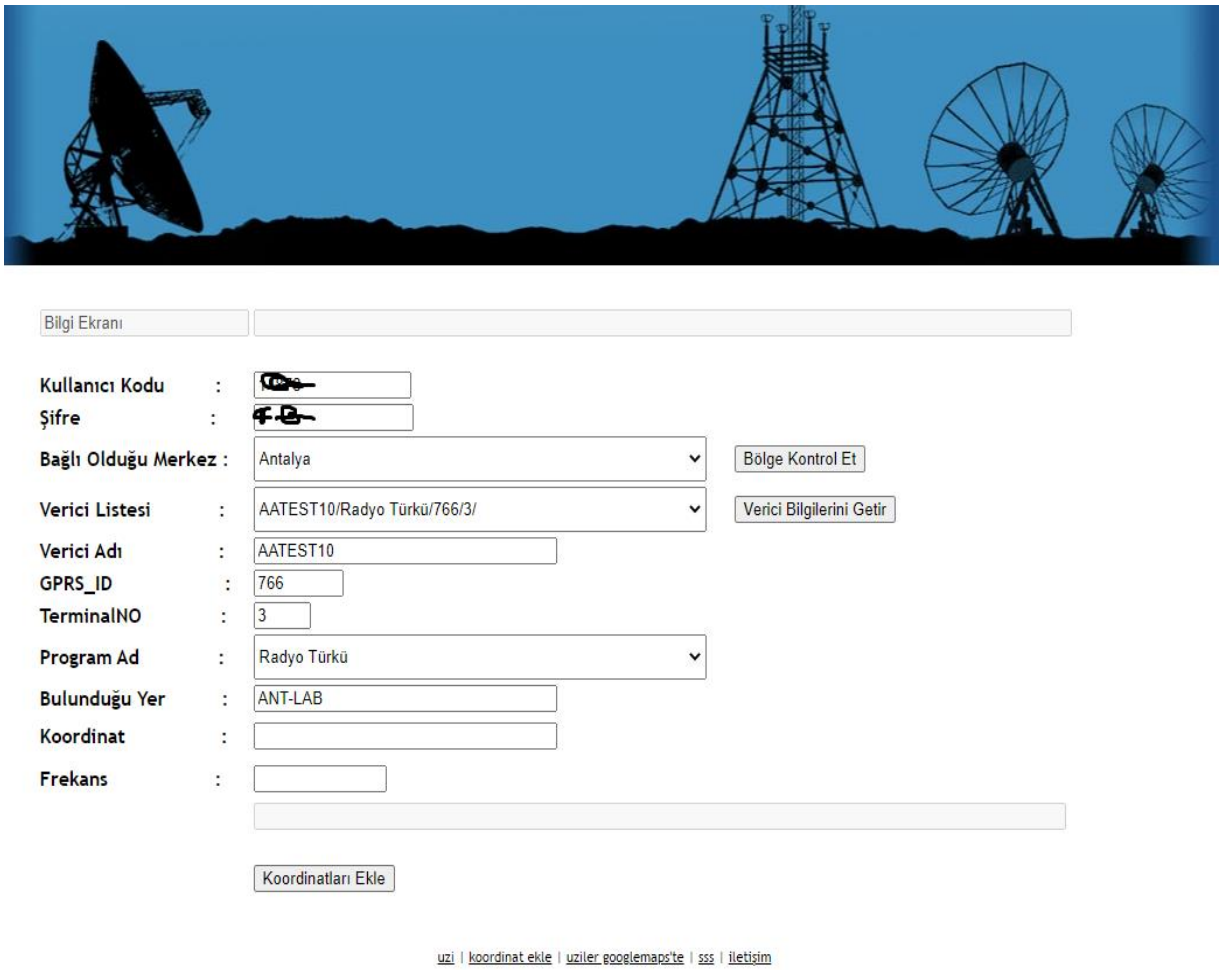

Figure 12. Transmitter coordinate management module

While all transmitters can be monitored instantly by the central unit, seven different regional managers can only follow the stations under their responsibility. The system can also be accessed from mobile devices. In this way, the teams on duty were given the opportunity to make a final status check before they set off to the station for control.

After the data from the stations were collected with the help of the collector, they were made meaningful with the help of parser. Stations reporting is provided from the web portal developed so that managers can follow the data. With Google Map integration, it is easy to follow with different colors (red, green, white) on the map. It was stated that the transmitters in the stations shown in the red color were completely closed and it was stated that immediate intervention was required. In the green transmitter station, all data were shown to be healthy. It has been shown that some values are lower than the reference values in the white colored transmitters.

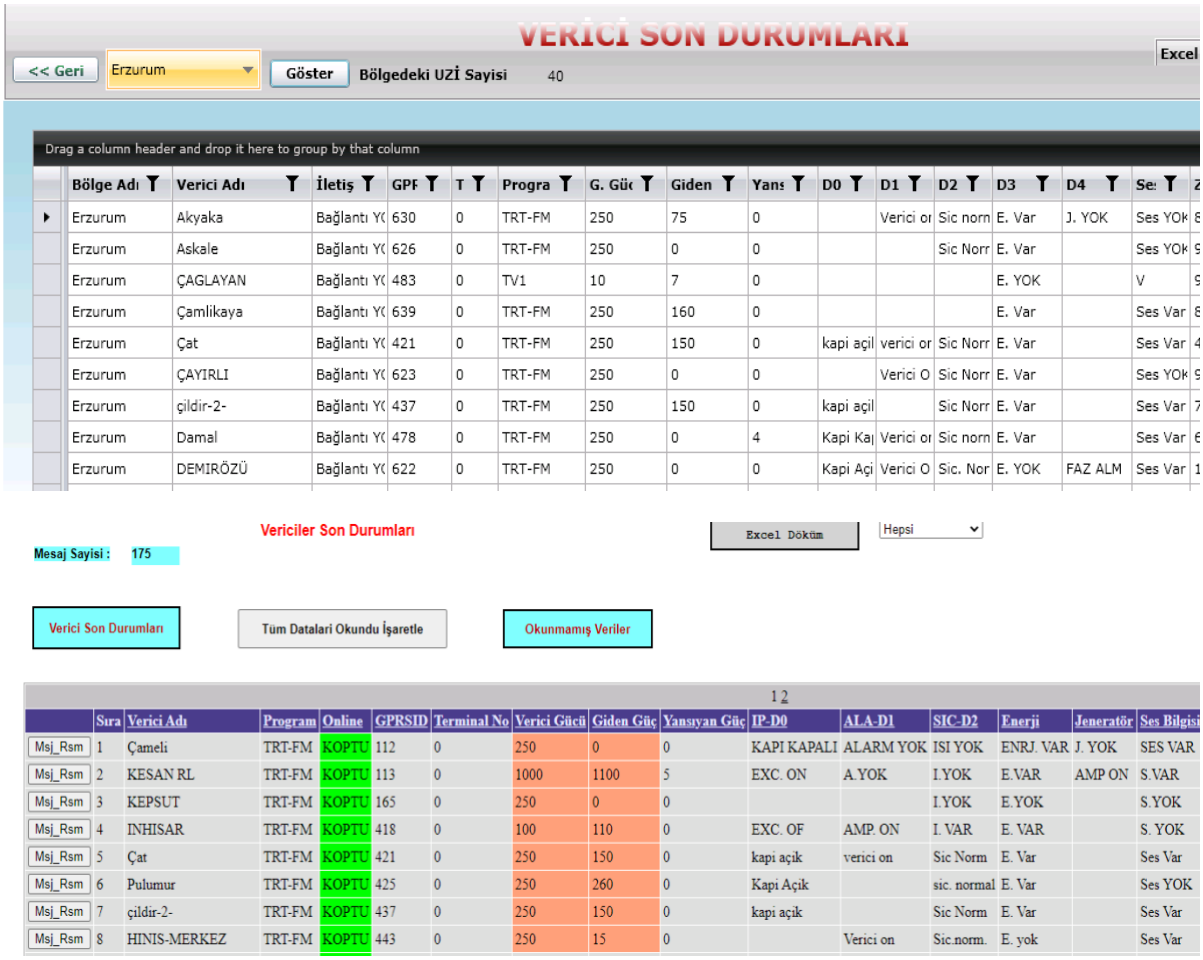

Figure 13. Transmitter Status Report

Setup information and I/O status information showed on the front panel LCD display (Figure 14).

Figure 14. 1U remote monitoring front panel (Power, Charge, Battery and LCD Display)

IV. CONCLUSION

By ensuring the monitoring of transmitters in regions where there is no personnel, it was ensured that they were intervened as soon as possible. After the pilot application tests, a system was created that allows monitoring of more than 1000 radio and television transmitters in 7 regions. Relevant personnel were immediately informed about the problems. Unlike other systems, this system allows it to be connected to FM / TV transmitters of different brands and models. By assigning the ports to the desired data source centrally, it is possible to receive different data from different devices for the ay port. In some cases, some problems were solved remotely by resetting the remote transmitter.

Gains of the System;

- time oriented
- Efficiency oriented,
- effective use,
- To help reduce maintenance-repair costs,
- To reduce personnel errors,
- Increased security of station

On the other hand, defective products or models with many failures have been identified together with the statistical data. These data assisted with investment planning for future years.
In the future, it is aimed to conduct research on blockchain-based systems that collect SNMP supported fault information from the transmitters.

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