PC Based Open Standard Radar Display System

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Abstract

This paper describes an implementation of a new PC based RADAR monitoring system which mainly eliminates some limitations in the current monitoring system and introduces some advanced features over the current system. The project covers implementation of two main functional units, open standard interface unit and web based monitoring unit. The open standard interface enables interfacing different Radar data protocols to a normal PC through the USB interface and this data can be used to develop any application that may process radar data and in this particular project we have developed a display application to monitor traffic. Providing a web interface to monitor the radar data enables the user to access the system remotely. We have also added features such as Traffic Statistic Recording, identifying various issues in radar units such as loss targets, patches etc with the purpose of enhancing the functionality of the display system

1. Introduction[1]

Air traffic controlling is one of the industrial utilizations of radar technology. It is a vast network of people and equipment that ensures the safe operation of commercial and private aircraft. Air traffic controllers coordinate the movement of air traffic to make certain that planes stay a safe distance apart. Their immediate concern is safety, but controllers also must direct planes efficiently to minimize delays. Some regulate airport traffic; others regulate flights between airports.

The current radar display system in Sri Lanka is a customized system which uses two radar serial data protocols and also the main monitor is centralized and users are incapable of accessing it remotely. This causes a lot of inefficiencies in its operation and maintenance tasks due to its own limitations. Users are also unable to carry out even a slight modification to the display system because the display system is inaccessible internally. Therefore a major industry requirement has emerged to develop a system where users can access radar data through a open standard interface so that they can use the data to develop different applications.

As a solution to the above mentioned problems we have introduced a new PC based monitoring system with some enhanced features through this project. The project includes implementing two main functional units; Open Standard Interface unit and Web Based Monitoring unit. The Open Standard Interface enables interfacing different radar data protocols removing the first limitation of the current customized system. Providing a web interface to monitor the radar data provides the remote access capability. We also introduce some new features such as traffic statistic recording, Identifying various issues in radar units such as loss targets, patches etc with the purpose of adding some enhancements to the functionality of the display system.

2. Methodology

We have developed a hardware unit that will interface various radar serial data formats simultaneously, identify the required data frames and send this data to a database where we provide the open standard interface to the radar data for the user. The novelty of the project is basically associated with the designing of this hardware unit. The basic system architecture is shown in Figure 1. The PC based system consists of three units; database, application server and web server. The database stores the radar data coming from the interface unit and the application running on the application server processes this data to provide the required outputs on the display. These outputs are shown on a web page hosted in the web server; hence the end user can access these data through a web interface provided that the system can be accessed only by the authorized users. If we look at the architecture (Figure 1) of the system which is going to be implemented, we can clearly see that our system will appear with a novel architecture which is completely different from the current one.

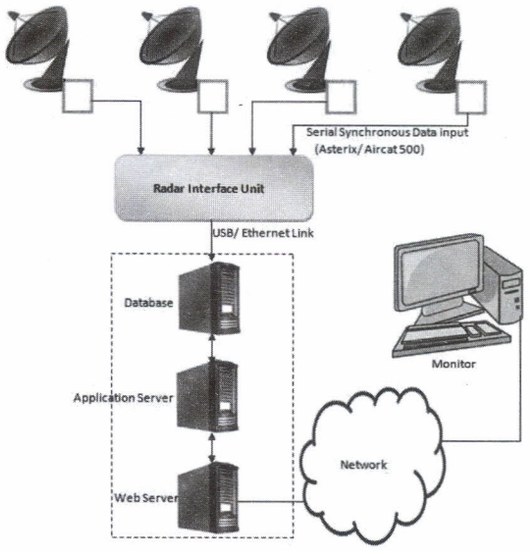

Figure 1: System architecture

2.1 Radar Interface Unit

This is the main hardware involvement of our project. The radar interface unit is used to convert the serial

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synchronous data which are coming from several radar towers located at different locations into a common data flow and that should be synchronized to have a common mean from all of them. These data will be transmitted to a normal PC via an USB interface.

This is a microcontroller based interface device. First we sample and decode the radar data coming from different radar inputs. Radar data comes in the serial synchronous format with a clock. Ultimately our design can be operate with ASTERIX and AIRCAT500 serial radar data formats.

ASTERIX data is coming in the High-Level Data link Control (HDLC) [1] frames and Aircat500 data coming in the Aircat protocol. The hardware unit samples and identifies the headers of the data packets and captures the data packets. Each input data stream comes to a separate microcontroller and it processes the data to sample and identify data packets and stores them in a temporary buffer.

These buffers then send the data packets to the USB interfacing chip through a multiplexer. Before sending to the multiplexer, we add a header to the data packet. This header is different for the data packets from the different Radar Data input streams because the purpose of adding headers is to identify them in the single output stream after multiplexing. Figure 2 shows the multiplexing functionality of the system.

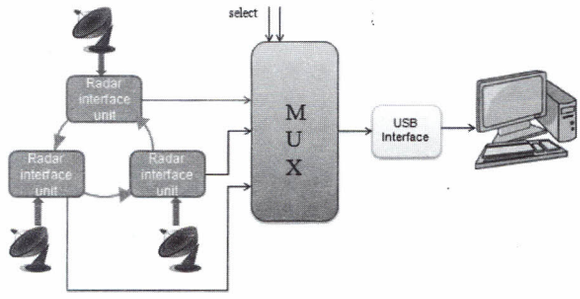

Figure 2: Radar data from different sources multiplexing into a single stream.

This multiplexed data stream is fed in to the USB interface. Its data transfer rates are upto1Mbyte / second and it uses a 128 byte receive buffer and a 256 byte transmit buffer.

2.2 Radar Capturing

It uses the 'ftdi' API to read the data coming from the USB device and those read data streams fed into the Database server using data capturing application. That application decodes [2,3] received data packets and processes to identify the information in the received data such as target identifier, location, etc. Finally this data is added into separate database tables for different radar data streams and each of them will be automatically created for a new day to increase the efficiency.

2.3 Radar Display Application

In the display application the system has the ability of real time Aircraft monitoring with remote access. It can access the database server through a private network or a LAN and display the aircraft's information on a client PC connected to the network which has the display application runningon it. At the start of the application the user has to select the database server. Then in the aircraft display window it reads the currently added data records and updates them on the display map in realtime. The display map contains 3 layers. The aircraft layer contains the aircrafts which are added to the application in real time through the database server. The grid layer shows the Latitude and Longitude grid over the map. The Air Track layer shows the air routes in the FIR. All these layers can be selected according to the user's requirement.

2.4 Web Interface

Our main target is to provide remote access to the radar display system through a web interface. Therefore we have developed a web interface using an Apache server as our web server and it will connect to the database server and will update the client page which includes the radar display map. As a result, the client web page which includes the radar display will update with the real time radar data information with only the web network delay. This will be a very useful application since it can be used by the general public as well, to check the positions of the required aircraft where necessary.

3. Results and Discussion

We have tested our system using the Microline Radar data record and playback unit. It has the capability of acquiring the actual radar data streams which come in the format of serial synchronous and record the raw data in a PC using interface software in the particular PC. Thus it can playback the recorded radar data streams through the same serial ports where they are recorded, and so we get the serial data streams from those serial ports to our hardware unit. The data record acts as real radar units to our system. Therefore we can test our system using that record and play back unit rather than always plug in to the real system.

This unit also has a post analysis feature which converts the acquired raw data in to the real message format and it was helpful for us to confirm whether there are any data misses in our system or not. But actually our system is more capable than the Microline as it ignores only the bit missed messages and acquires the next message onwards correctly.

Asterix sample data:
01 03 01 00 17 F9 01 02 42 1A 20 17 09 5D 20 01
67 04 D8 01 2A 08 B3 F8 73
Aircat500 sample data:
0C 40 FD 0C FE 0E 02 70 01 BC 03 E8 FC 12 22 E4
05 01

First we have analyzed the raw data messages which are in the hexadecimal format to confirm the validity of the system and then we have decoded them at our capture application to obtain a meaningful result from them and saved them in separate databases.

Thereafter, we were able to read this meaningful data through our display application and interpret the message data to the real time aircraft display screen. Then we would be able to analyze the display data validity when comparing them with the current radar display system.

Our system is very much a portable system since it can be used in a normal PC through the USB interface. Any computer which has the display software installed on it can access the database server, if it has the access privileges and then real-time and past radar information can be displayed on it. In addition through the web server, any normal computer can view the radar display on its screen as shown in Figure 3.

Since this system can display past records as well, it can be used for the training purposes for the air traffic controllers and the other relevant personnel. Also the past records can be used to analyze the special incidents that have happened in the past.

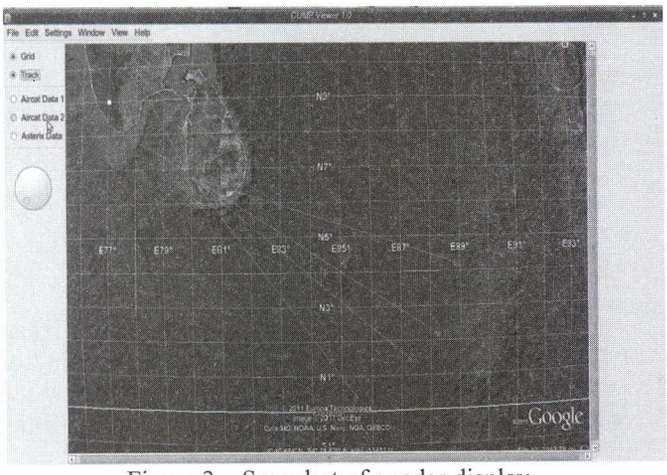

Figure 3 – Snapshot of a radar display

Furthermore, our hardware switching and tunneling unit is easily extendable to acquire more radar data streams since it has module wise design architecture and a ring type multiplexing algorithm. As a result, it can be extended to reach the maximum allowable delay without causing any misses in any radar stream. Our capture applications well as our display application are also capable of this extendable feature.

References

[1]. AUTO System Interface Control Document SICD, International Civil Aviation Organization .

[2]. Eurocontrol Standard Document For Radar Data Exchange, Transmission of Monoradar Data Target Reports, European Organization For the Safety of Air Navigation, August 2002

[3] . Eurocontrol Standard Document For Radar Data Exchange, Transmission of Monoradar Service Messages, European Organization For the Safety of Air Navigation, November 1997