Mobile Based Radar Display App

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Abstract:

In recent times, with advancements in the field of Smartphones, applications are evolving constantly. Use of Smartphones to view radar acquired data enhances the portability of deployment and real-time situational awareness. This paper provides a new perspective towards amalgamating Smartphones and user needs of viewing radar target data on portable devices at remote locations, bringing Smartphone technology to the edge of tactical environment.

Keywords: Smartphones, radar, target, tactical environment.

I INTRODUCTION

With fast evolving technology and research in Smartphones field, the mobile phones are finding use in every available space from a users' perspective. A single Smartphone handles multiple tasks starting from conventional usage e.g. making calls, to more user specific services viz, GPS Navigation, Shopping Portal, Health monitoring, Online banking, e-commerce Portal to name a few. With faster internet connectivity, the Smartphones have become the fastest and most preferred way of data and information exchange.

With passage of time, every new Mobile gadget launched is more capable and powerful than its predecessor and offers generous memory. Increased processing power, connectivity over a variety of communication media interfaces, enhanced battery life, improved speeds, variety of informative commercial mobile apps and larger screen sizes with touch screen operation has made information available at the touch of a fingertip.

This paper presents a novel approach towards utilizing these tremendous capabilities of Smart phones in tactical role for radar display applications at various echelons.

To this date the radar display applications have been running on bulky hardware with high end expensive processor boards for the need of complex backend processing and graphics related operations required for the display operator. All radar operations are monitored and controlled through a radar display. But in areas of strategic importance where simplistic presentation of real time information is of vital importance, primary requirement is a solution that has adaptability to connect to different media, presents meaningful information, adequate battery life, portable and easy to operate.

In strategic deployments where real time information is of utmost importance to facilitate early warning for faster and quality decisions smart phones can offer a handy and preliminary solution to mission critical operations for status monitoring of radar operations from a distance.

II TECHNOLOGY OVERVIEW

Open source nature of Android OS has facilitated a large scale development and easy availability of required services in the world of Smartphones. The application development philosophy which is followed here is therefore based on Android System and it utilizes the framework provided by Android SDK as development baseline.

III EXISTING SYSTEMS

Radar Display Systems are a critical resource in any radar system from mission point of view. They provide user/operator with extensive GUI features which enables the operator to view the target information and take decisive actions based on the mission situation. A typical image of radar display is given in Fig. 1 below:

Figure 1: Radar Display [1]

The soldiers/operators whether present at the radar site or at any remote location like to have real time updates of target location. Currently this requirement is fulfilled by using following hardware with their software applications:

- Radar Display installed at the radar site.
- Communication Interface Unit installed at radar site which acts as interface between radar and radios.
- V/UHF Radios installed both at transmitting side (radar site) and receiving side (Remote site).
- Target Data Receivers at remote site.

The Radar Display which are co-located with the radar need to be very elaborate and functionally well equipped to enable operator to operate on radar and control various parameters; whereas for the soldiers / operators who are accessing the target information remotely , their priority is to view the targets related to their area of control. For this functionality, Target Data receivers are developed which mainly act as the local target display devices based on the location of soldier. A typical Target data receiver screen is shown in the Fig. 2 below:
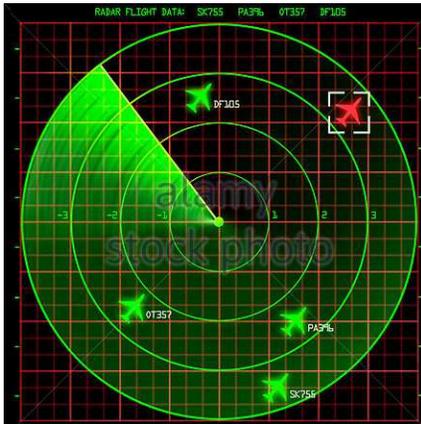

Figure 2: Target Data Receiver Screen [2]

The above-mentioned arrangement had following limitations:
- Range limitation of serial/ VHF interface.
- Reduced portability due to bulkiness.
- Power Backup issues

To overcome these limitations, we have come up with the idea of utilizing smart phones for this requirement. Due to easy handling and operation of smart phones, they can be used to view the Air Situation Picture with respect to any radar/ operators' location.

IV PROPOSED SYSTEM

Our aim is to utilize Smartphones as target data receivers which will receive target information over Wifi network.
Each Smartphone will display targets with respect to its geographical location. It will have following salient features:
- Real time tracking of targets.
- Selected Target Information availability at a single touch.
- User configurable location mapping.
- Target display over a Raster map underlay.
- Local area Connectivity through Secure Wifi access points and increased area of coverage through use of routers.
- Data encrypted through Encryption algorithms.

1 System Architecture

This mobile based radar display app is based on point to multipoint architecture as shown in the Fig. 3 below:
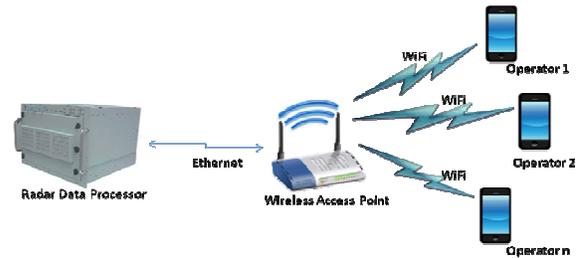

Figure 3: App Architecture

The target information is available at Radar Data Processor (RDP) end. RDP is connected via copper Ethernet to Wireless access point which converts the communication media to wireless. This access point can also act as DHCP server, providing same class IPs to all the connected devices.
RDP sends the target data to all connected Smartphones periodically at a predefined rate.

2 Technical Requirements

The development of this App requires following resources / software:
- Windows 7 Operating System
- Qt 5.8 for Android for Mobile App Development
- Android Studio
- .NET Framework 2.0 or later
- Mobile Atlas Creator

As for hardware requirements, following devices were used:
- Intel Core i7 processor with 12 GB RAM as development platform.
- Wireless Access Point
- Android based Smartphones for real-time testing purposes.
- Associated Cabling.

V SYSTEM DESIGN

The proposed system is designed to facilitate users' ease of operation and is henceforth divided into following modules:

1 Authenticated User Login

The operators located at any site can login with username and password as shown in Fig. 4.

Figure 4: Typical Mobile Radar App Login Page

2 Geographical Location Details

The user details are authenticated and if credentials are found OK, app navigates to Locations window.

Figure 5: Typical Mobile Radar App Locations Page

In this Locations window (Refer Fig.5), user need to enter its own geographical location through Manual Entry or GPS based entry, radius of coverage (AOR) and geographical location of the Radar. After filling these details, the user navigates to Target Data Display window, as shown in the Fig. 6.

3 Target Data Display

Target Data Display is the home page which has following salient features:

- It displays the real time position of targets with respect to the radar.
- The targets are displayed against raster map background. The map is by default cantered to the user's location.
- User can select any targets and view its detailed information e.g. Track-ID, Range, Azimuth, Altitude, Speed, heading and secondary information on selected target information window.
- The target information can be viewed as per metrics and Role selected in Settings page.

The center of the map is the user location by Default. There is facility for the user to centralize the map as per users' current location or radar location by clicking "User Location" / "Radar Location" button respectively.
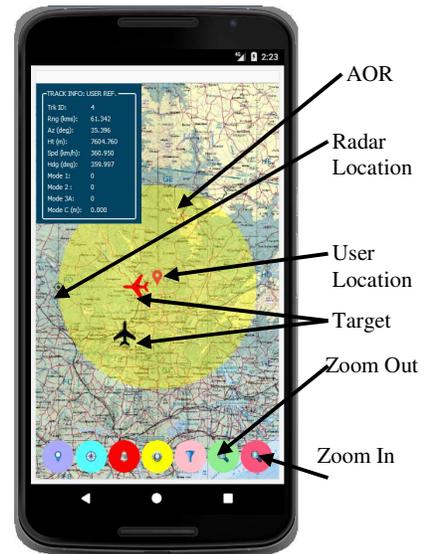

Figure 6: Typical Features of Application

User can view target information by double-tapping on any desired Target. As the target is selected, its colour changes to black and a Target Information Window appears displaying target information updates in real time (Refer Fig. 6 above). This information can be with respect to users' geographical location or with respect to radar's location depending upon "Role" selection in "Settings" Tab.

User can configure the settings viz. Setting the target information reference and metrics used for target information display through "Settings" button on home page.

The app can be configured to generate alarms in case of any emergency situation through "Alarms" button.

Further the user can filter the desired type of target by turning on certain filters through "Filter" button. "Zoom In" and "Zoom Out" buttons are additionally provided for changing zoom levels of display area.

4 Network and Data Security

To suit to defence requirements, ensuring data security is a must. Security concerns are addressed through standard means available today however quickly emerging cyber threats offer new challenges and ample of scope for hardening security features in future:

1. App Level security through User Id and password authentication
2. Network level Security through different WAP security features.
3. Data level Security through Encrypted data transfer.

These three levels of security provide a secure environment of data transfer between network and client mobiles. First two are in-built facilities available in network systems now-a-days.

VI MERITS OF RADAR DISPLAY APP

This application provides various advantages for operators as listed below:

- Radars are deployed in field and the radar operations can be monitored by a superior/ head from his office or even when he is on move.
- It can act as a target data receiver.
- Users can get detailed target information of any selected target he wishes to see.
- Various filters can be set in order to view some specific targets only.

VII FUTURE DIRECTIONS

The App developed so far has a vast scope of improvement in future. Some of the planned directions we are looking forward to in future are as follows:

- Use of worldwide standard format of radar data to create a generic solution for all requirements.
- Implementation of GIS for maps to provide user with a better accuracy in relation to map viewing and locating a target.
- Radar health status App for radar maintenance.

VIII CONCLUSION

This paper brings forward the concept of using Smartphones in a novel way in radar applications. This solution brings a commercial smart phone technology at the tactical edge as this novel concept equips the user with a handy radar viewport solution for monitoring real time ASP (Air Situation Picture). This approach aims towards enabling user with better experience while on mission operation at sites.

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