3.1 THE 21st CENTURY'S AIRPORT WEATHER REPORTING SYSTEM

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1. INTRODUCTION

Coastal Environmental Systems has built and is delivering a complete meteorological and RVR (combined) aviation weather monitoring system. The system is suitable for CAT I, II or III airports (or smaller) and measures and reports RVR in addition to all the meteorological parameters. The overall system is very flexible and expandable for a wide variety of aviation applications. The following paper describes this system and some of its abilities.

2. SYSTEM DESCRIPTION

The system has multiple purposes:

- Display the required weather sensor data in a GUI
- Allow multiple displays to connect through a variety of means
- Allow users to have different levels of access
- Provide a Ground To Air voice output
- Provide a dial in voice output
- Feed data to other systems (where applicable)
- Provide remote maintenance monitoring via the Internet

The system is composed of three major sub-components: Field Stations, the Terminal Data Acquisition and Dissemination System, and the User Interface Devices. Each subsystem is discussed in further detail below. All of the components of this System are Commercial Off-The-Shelf (COTS) items.

3. Field Station (FDCU)

The Field Station is scalable depending on the need. It contains a Coastal ZENO®-3200 with ZENOSOFT™ firmware combined with a SSEM (Serial Sensor Expansion Module) to take data from a nearly endless variety of sensors. The field station can serve as a primary or secondary group of sensors. If it is functioning as the primary group it has the following sensors: – wind speed and direction, ambient temperature, relative humidity, pressure sensors (3), visibility, ceilometer, present weather (precipitation ID), amount of precipitation, freezing rain, lightning detection and ambient light. Alternately, the field station can be configured to be a mid-field sensor group (typically only visibility) or an "other end of runway" group (typically visibility, winds and ceilometer).

The field station converts the raw readings to engineering units. It carries out quality checks on the sensor readings as well as regular hardware self-tests, such as checking the ability to communicate with a serial sensor. It calculates a variety of other parameters including cloud height, obscuration, dew point, altimeter setting, RVR and other relevant data.

The following is a table of the sensors used and the manufacturers:

Sensor	Mfg.
Wind speed and Direction	RM Young & Taylor
Air Temperature	YSI
Relative Humidity	Rotronics
Pressure/Altimeter	Druck
Rainfall	Met-One
Precipitation ID	OSI
Ceilometer	Eliasson
Visibility	Belfort
Ambient Light	Belfort
Freezing Rain	Goodrich
Lightning Detection	GAI/Vaisala
Aspirated Temperature Shield	RM Young

Table 1: Sensors and Manufacturers

The field station is polled by the TDAU and can be done through direct cable, short haul modem, fiber optic, UHF radio or a combination of these.

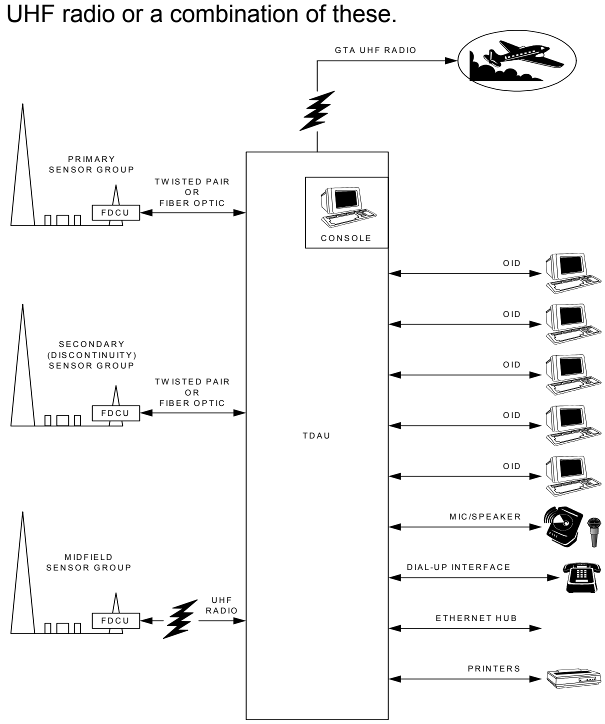

Fig. 1. System Block Diagram.

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3.1 ELECTRONICS AND ENCLOSURE (field station)

The ZENO®-3200 and SSEM are housed within a corrosion-resistant aluminum NEMA 4X Enclosure. The backplate of the FDCU includes a power distribution module, surge and transient protection (TP), and a heater strip. The power supply provides power to the FDCU, its heater, all the sensors and their associated heaters. The heater strip allows for extended operation of the system at low environmental temperatures. We are using 4 levels of diversion and protection to protect the electronics against lightning and other transient noise.

The FDCU is tested to, and compliant with, MIL-SPEC 461 for EMI and RFI.

3.2 Terminal Data Acquisition Unit

The TDAU has the primary responsibility for data acquisition, processing, formatting, sorting and distributing data received from the sensors via the FDCU. The TDAU processes the data through a series of algorithms[2] to produce METAR and SPECI reports. The TDAU also controls the system's maintenance and diagnostic routines, archiving and system timing and control. It consists of (from top to bottom in the photo below) a panel containing all the communication "modems", the Ground To Air Radio (GTA), a server, and a UPS.

Fig. 2 Terminal Data Acquisition Unit

The server processes and distributes data to the Operator Interface Devices (OID's), which are thin-client based computer terminals. A communications processor handles all the servers' serial communications. The server also contains a voice processor to support the GTA radio and the dial in telephone lines.

4. Operator Interface Device (OID)

The OID is a thin-client based terminal. It has no media drives and is therefore immune to virus problems. This means the entire system can be upgraded by updating just one set of software on the server. A microphone and speaker are typically provided with one of the OID's

An OID can have a 15 inch flat panel, a 10 inch flat panel or a 10 inch console mount flat panel display.

Fig. 3. Installation showing Primary Group.

5. RUNWAY VISUAL RANGE (RVR)

Runway Visual Range is used by pilots to determine how well they should be able to see down the runway or the runway lights. It is a measurement that combines the extinction coefficient and visibility sensor with the ambient light sensor, and then measures the intensity setting of the runway lights. The touchdown, midpoint, and rollout RVR values are displayed for each runway (assuming 3 visibility sensors at the primary, center-field and other end of field). This is based on the instrumentation on the runway and its rated landing category.

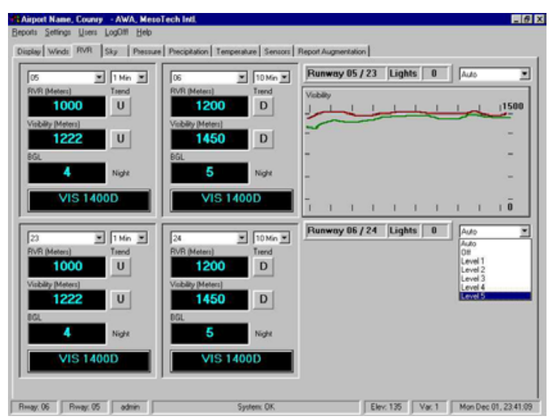

Fig. 4 Sample GUI display showing RVR

[2] The algorithms are compliant with FMH-1, ICAO and WMO

6. MAINTENANCE AND TROUBLESHOOTING

This system was designed to be easy to maintain and troubleshoot. Components with minimal routine and preventative maintenance requirements were chosen. Faults are identified by a battery of BIT, BITE and other self tests run at various levels in the system (at the Sensor, at the FDCU and at the TDAU). This diagnostic information can be accessed at any OID or through Remote Maintenance Monitoring (RMM). A series of maintenance logs compile and store all the data for easy selection and review.

Remote Maintenance Monitoring is done with a Web Browser for any location given the user has the correct security and password clearance. Data from the system is used to generate a web page, which is then viewed via a browser, leaving the system very secure.

7. CONCLUSION

By using Coastal's, and other sensor manufacturer's COTS products, Coastal was able to assemble and build the most complete and seamless airport weather station available. Combining RVR using the new forward scatter visibility sensors was the next logical step for a complete airport weather system. Making it very modular and expandable while maintaining only one source of software on one machine was inevitably the next step to take. Coastal plans to deliver in excess of 250 systems over the next 5 years.