Implementation Automatic Packet Reporting System (APRS) for Weather Station

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Abstract

Nowadays, weather monitoring is indispensable. The data obtained in the present or past can be a reference to predict future weather, can be used to determine the condition of the antenna on ground stations in the face of extreme weather. It is necessary to have a tool that can read the parameters of the weather, because the importance of weather monitoring. Automatic Weather Station (AWS) This type of ADS-WS1 is a tool that can read several parameters of weather quantities such as rainfall, wind direction, wind speed, temperature, humidity, and pressure. It has equipped with sensors to read the number of weather parameters. ADS-WS1 not using internet networks, but use radio frequencies for sending a sensor data that has connect to the transceiver. With that frequency the signal will be transmitted and received via satellite or terrestrials with Automatic Packet Reporting System (APRS) through radio frequency and Internet gateway or known as (iGate). The result from the sensor that have been installed at the PUSTEKSAT ground station can be monitored both on Radio Frequency (RF) and Internet, the purpose of this research is to send weather data station with APRS format via Radio frequency, this a proof of concept for sending weather information via APRS format system.

Keywords- AWS, APRS, Radio, ADS-WS1, Frequency

1. Introduction

Weather monitoring is necessary at this time, considering that it is important for humans needs to do various things. Data obtained in the present and the past can be a reference to predict future weather. So that we can anticipate the occurrence of bad weather through predictions. The tool to be able to read the magnitude of the weather is important given the need for weather monitoring[1].

Automatic Weather Station (AWS) This type of ADS-WS1 is a tool that can read several parameters of weather quantities such as rainfall, wind direction, wind speed, temperature, humidity, and pressure. The tool is equipped with sensor to read the magnitude of weather parameters [8]

The application of APRS as a Weather Station has been widely used. However, the transmission of weather station data uses the internet network [2]. Seen in Fig. 1, shows data transmission using the internet network, marked with the information "APRS via TCPIP". The goal of this research is not to send data packets through an internet connection but via radio frequencies that make this system can work independently. The ADS-WS1 does not use an internet network but uses radiofrequency, an amateur radio world used a VHF band with a frequency value of 144,390 MHz for Terrestrial and 145.825 MHz for via satellites. Through these frequencies the signal will be transmitted and received by the Automatic Packet Reporting System (APRS) I-gate, and data can be viewed both directly on the APRS monitoring system and web-based on www.aprs.fi [9]. The automatic weather element observation system has been developed for quite a long time in developed countries, but the price is quite expensive so that its use is still very limited in Indonesia [3]. Therefore APRS-based ADS-WS1 can be an alternative for Low Cost based weather monitoring. This study utilizes APRS as a Weather Station using radio frequency VHF as a media for transmitting weather monitoring data.

The data can be look up directly via handy transceiver that have APRS decoder or can connected to personal computer for decode an APRS data if the radio don't have that functions. For easy monitoring, this weather data packet can also be seeing at the internet web based

via APRS gateway that have connected to internet server like www.aprs.fi.

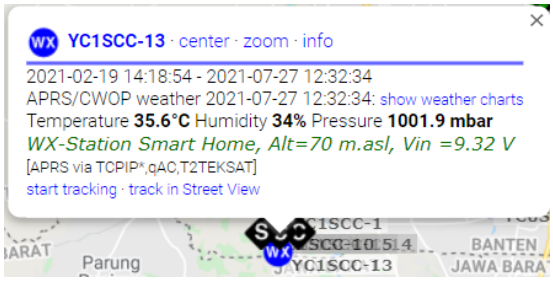

Fig. 1. APRS Weather Station via TCPIP (www.aprs.fi).

In general the weather station monitoring system in general the data read on weather sensors is displayed directly on the display screen available on the device. In this system the measurement data is implemented on the APRS data packet that can be sent via radio waves in the form of data packet so that it is not only received at the measurement location but also can be received at a remote location and by using a system of radio waves that are emitted then this can stand alone independent of the internet network

2. Research Methodology

2.1 Weather Station System Equipment

The ADS-WS1 is a module APRS weather station suitable for direct connection to a radio (Fig. 2). This device is the main controlling of the weather sensors that are connected to read the weather conditions on the measurement area. Sensors that connected to the ADS-WS1 are anemometer, wind speed and rain gauge. The anemometer is used to determine the blowing wind speed. The Wind Direction is used to find out where the wind direction is blowing. And the Rain Gauge is used to measure the rainfall that occurs in the measurement area. This device is also equipped with temperature, pressure and humidity sensors.

Fig. 2. ADS-WS1 Weather Station and Anemometer, Wind Speed, Rain Gauge Sensor

The basic concept of how this system work is shown in the flowchart in Fig. 3, the first system start will initialization the devices and try to get the data from all sensor like temperature, humidity, pressure, wind, and rain sensor, if all parameter can be read the next step the system prepares to set frequency radio if not will go back to try read again from the sensor, and then the system will send the database on APRS format through radio frequency that can be received from any gateway station, this proses will continue looping every 10 minute.

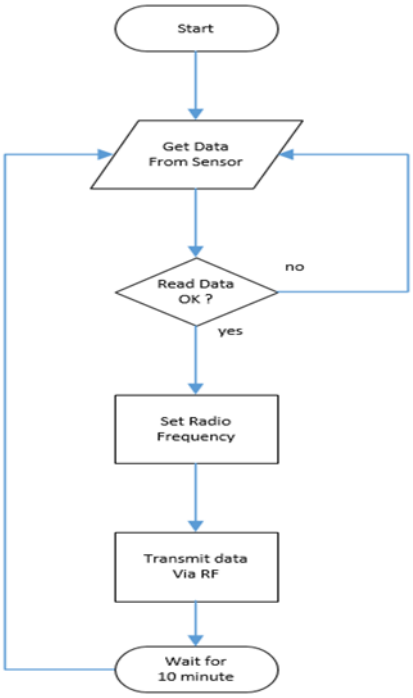

Fig. 3. System Flowchart

2.2 ADS-WS1 with the APRS System

This system will be explained how the device works from weather sensor readings to data that are read on the webserver APRS. The implementation of the Weather Station system is in LAPAN Pusteksat - Rancabungur and the installation is done and working properly for around one year. The conFig.uration scheme can be seen in Fig. 4.

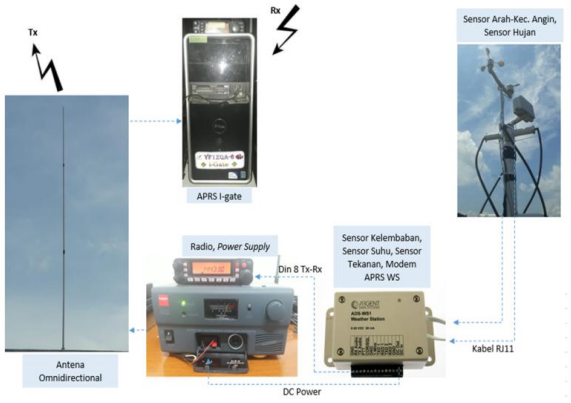

Fig. 4. APRS Weather Station System ConFig.uration

The sensor here is separated into 2 parts, the first is there is a wind speed sensor, wind direction, and rain sensor. Then there are sensors that are include in the APRS modem, namely humidity, temperature, and pressure.

The way the APRS Weather Station works is the sensor will be read by an APRS modem and then the output from the device in the form of an audio modulation packet signal that is connected to a radio transceiver to transmit data via radiofrequency. The frequency is set at 144,390 MHz where this frequency is the terrestrial frequency for digital data in the distribution and plans usually on amateur radio, and for sending data through satellites the frequency is switched to 145.825 MHz (most of the satellite payloads use this frequency). The use of this amateur radio band refers to the permission obtained at the Pusteksat Ground Station with a YF1ZQA callsign permit, through this radio will be transmitted via an Omni-antenna directional or any kind of antenna that working on VHF frequencies. The results of the entire system output can be read either directly using the radio or on the APRS web server after being received by iGate (Internet Gateway). The function of iGate is to feed APRS data received on a radio wave-based terrestrial basis to be forwarded to the APRS server on the internet, and for monitoring can be looked at via the internet [6] the gateway currently in use is the APRS iGate owned by LAPAN Pusteksat Bogor.

3. Result and Discussion

3.1 Parameter Setup

APRS modem is one of the most important parts of the process of sending and receiving APRS packet, which the modem works as digital signal converters into analog signal before information is transmitted through radio wave and convert analog signals into digital signals when receiving APRS packet information [7]. The message that will be transmitted through the antenna is arranged in advance so that it can send the desired message, the contents of the message should be brief, clear and identify the sender's data. The settings are made in the modem by setting some parameters as in Fig. 5.

The Voice ID YF1ZQA in the picture is the Rancabungur Ground Station call sign where for the weather station itself is marked with ID YF1ZQA-13, the Path is also important considering that this message using WIDE 2-2 can still be forwarded or through the Digipeater station so the reach will be further. The system will transmit once every 5 minutes and can be monitored through a web server after the signal is received by iGate.

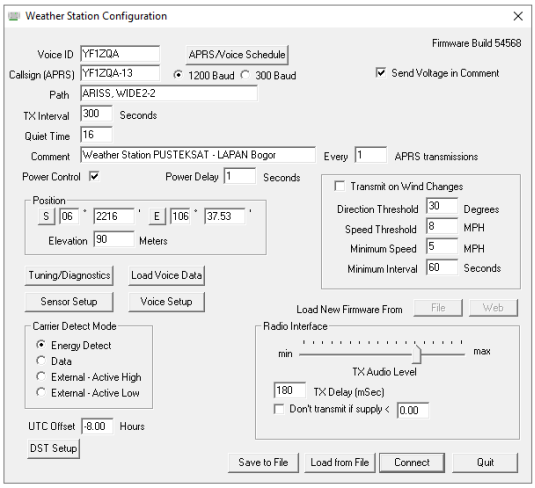

Fig. 5. APRS-WS1 Modem Setup

In Table 1 we can see the sensor that ADS-WS1 have is a good tolerance when compare with equipment that we already have in the room. Base on this compare ration we can make sure if the sensor is in good condition.

Table 1. Temperature & humidity measurement with ADS-WS1

ADS-WS1		Temperature & Humidity Measurement	
T (°C)	H (%)	T (°C)	H (%)
29.9	70	29.5	69
30	70.2	29.7	70
30	70.3	30	69
30	70.4	29.9	69
29.9	70.5	29.8	70
29.8	70.5	29.7	70
29.7	70.6	30	70
29.2	70.7	30	70
29.0	70.8	29.4	70
28.9	71	29.4	71

The scope of this APRS infrastructure is not limited to iGATE and re-transmitters, but there are many more that can be applied either terrestrially through satellite use, APRS Tracker which can be used mobile or sending APRS data via satellite for a wider range of distance, infrastructure overview APRS can be seen in Fig.6.

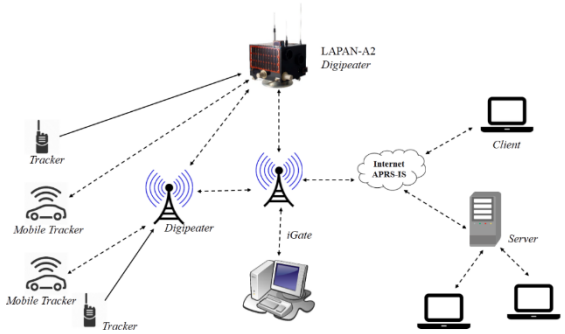

Fig. 6. APRS Infrastructure

Data APRS transmitted from weather station via radio frequency directly can received by the ground station will be displayed and decode it in the form of a map as shown in Fig.7 below.

Fig.7. Raw Data APRS Weather Station YF1ZQA-13

Weather Station itself will use YF1ZQA-13 for the callsign, number 13 in APRS system its mean SSID (Secondary Station ID) that used for describe function of what station kind is and SSID no.13 usually use for weather station. With this ID make YF1ZQA-13 is the station in APRS system that give us information of weather condition in that location.

3.2 Raw Data Service

Data in the form of packets received from the APRS weather station every 5 minutes either through the I-gate directly or through the Digipeater before entering the I-gate. The raw data can only be displayed up to 2 days past the last data that has been received. But for graph data can be seen starting from daily, weekly, monthly, until the most complete data is annual. The application of the weather station after an effective reset was installed at the Rancabungur ground station in mid-January 2020, in this station there is also an iGate receiver and APRS data transmitter and transmitter system [4]. The re-transmitter system or Digipeater is intended so that the data sent over radio waves becomes even farther [5]. The weakness of the data monitored through this website is the drawback of the graphic display that is there no accumulative average value of the data that has been stored, but for extreme values can be directly observed clearly through the graphic display like in Fig.8.

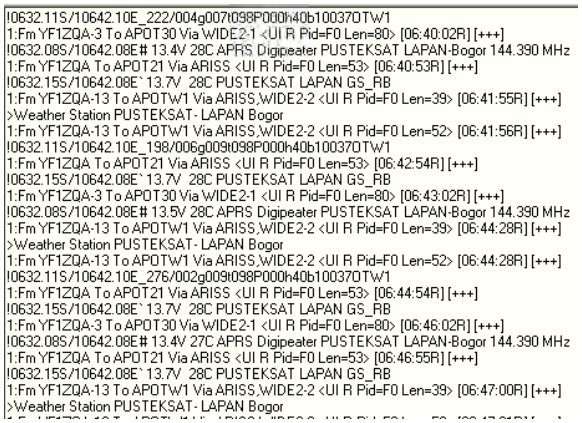

Fig.8. Data Packet Receive via RF

The data contained in the packets is in the form of brief information about the data from the weather station and is continuously updated every transmit (in this example is every 5 minutes). The size of the sensor can be easily identified through the display of the map.

Several data on the packages can be separate by decoding the APRS data packets. And can be describe base on the sensor function itself like temperature and humidity result in Fig.9.

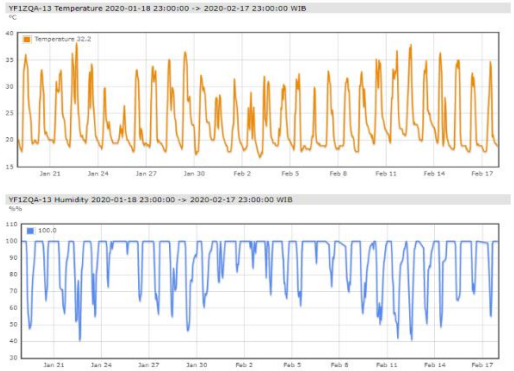

Fig.9. Weather Chart Humidity and Temperature on site

Another packets from the sensor that used in weather station is a pressure and wind direction that the result like in Fig.10 below:

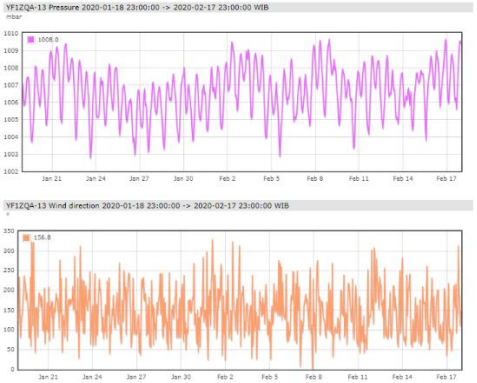

Fig.10. Weather Chart Pressure and Wind Direction

The last sensor that weather station brings is a sensor for rain condition on the measurement location, that can be used for knowing a rain situation on location for a couple of hours or days like showing in Fig.11

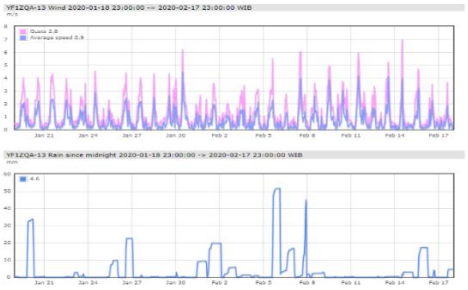

Fig.11 Weather Chart for Wind and Rain

For the independences system all packets weather data can be seen on the radio directly via RF wave that have capability for decode APRS data packets. If a radio does not have that capability for decode APRS data packets, we can connect it to a computer for decode that data and see the information's inside. For radio that can decode directly on the fly can we see like in Fig.12, this type of radio can show us the information from the APRS packets that has been decode.

Fig.12. APRS Weather data directly receive on the fly

And for the last that can be easy for us monitoring the weather data packets from the station is via internet web base like in Fig.13 below.

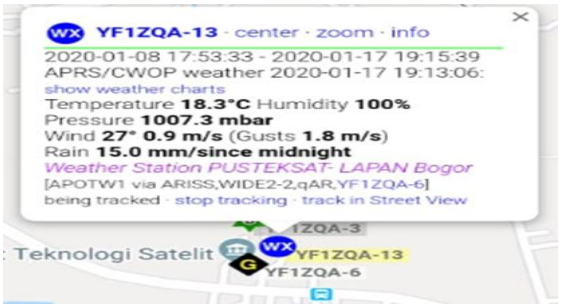

Fig.13. Maps Static APRS Weather Station at Pusteksat Ground Station

4. Conclusion

With the APRS system in the form of ADS-WS1, we can monitor weather station using VHF radio frequency, this will be very beneficial when data can be transmitted and received without using an internet network. Sensor readings that have been installed at Pusteksat ground station currently have the following values, Temperature is in the range 16.8 - 37.8 'C, Humidity 46 - 100%, Pressure 1003.5 - 1009.6 mBar, Wind (Gust) 0.0 (0.3) - 2.9 (5.3) m / s where gust is a change in wind speed, wind direction is evenly distributed in all azimuth directions, and Rain is 0 - 51.6 mm. This research proof the concept for sending data weather station base on APRS format via radio frequency that make the data can receive manually with radio equipment or monitoring on the internet from the iGate. And the data will updates every 10 minutes to the system and send back to RF or can be set any minute we need it. In future research, we hope APRS can be useful for any kind of data or can be made with very low cost infrastructure and can be implemented in any kind of area.

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