

## DEVELOPMENT AUTOMATIC NOAA WEATHER STATION USING RASPBERRY PI AND RTL SDR RECEIVER FOR DEEP SEA FISHERMEN

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### ABSTRACT

The information regarding weather forecasting is important for public and specifically sea-fearer to be predicted especially on waterways to navigate the ships and vessels. Bad weather can cause ship to collide with each other. Thus, the project was developed to reduce risks and help ships and crews to make decision in operating their ships. Basically, the development of an automatic National Oceanic and Atmospheric Administration (NOAA) weather station using Raspberry Pi and RTL SDR receiver for deep sea fishermen” has been introduced to solve this matter. The NOAA weather station is the automatic weather station that is basically will help the fishermen to know the weather condition while at the sea doing the fishing activities. It operates by sending the visible image of the condition of the place when the fishermen set the coordinate which are the latitude, longitude and altitude. Apart from that, the benefit of using this project, it does not require having the internet source to know the condition of the weather so, it will help the fishermen to know the weather condition while on the sea without risk their life. Furthermore, this automatic weather station also can reduce the burden of the fishermen that has no budget to buy it because the price of this project is very affordable.

**Keywords:** *Raspberry Pi, SDR receiver, visible image, NOAA, altitude*

### 1. INTRODUCTION

Weather forecasting has always been an essential part of man’s numerous activities including day to day agriculture, seafaring, and deep sea fishing. Over the past decades, weather forecasting has been carried out using satellite; internet is the other sophisticated equipment that has been use. Nowadays, as the development of electrical application are widely use especially in marine activities. This project uses the Raspberry Pi and RTL SDR receiver to get weather image. The Raspberry Pi is low cost and credit-card sized computer monitor or TV, and uses a standard keyboard and mouse. [1] Apart of that, V-dipole antenna provides the advantage of transmitting balanced signals. The dual-pole design allows the system to receive signals from various frequencies. Therefore, the V-dipole antenna has been use to receive the Automatic Picture Transmission (APT) signal from three types of National Oceanic and Atmospheric Administration (NOAA) weather satellites which are NOAA 15, 18 and 19.

The National Oceanic and Atmospheric Administration (NOAA) is an American science agency within the U.S Department of Commerce that report on ocean environments, global rivers, and atmospheric conditions. The RTL SDR translates the Automatic Picture Transmission (APT) signal to the audio signal after the Automatic Picture Transmission (APT) signal receives from the dipole antenna. Then, the Raspberry Pi captures signal and decodes images during predicted satellite passes. And there is the monitor that takes the output from the Raspberry Pi in the form of visible image. The

FYP project focuses on the use of the sea for forecasting weather purposes while aboard ships and helps the fishermen in deep sea activities.

## **LITERATURE REVIEW**

### ***2.1 Renewable powered portable weather updates station***

The Develop of a RES powered Weather Station which will help to monitor the weather parameters. Besides, the project also contains sensors for detecting temperature, humidity, raindrop, carbon monoxide, smoke, LPG in the environment, barometric pressure. Apart of that, the information from the sensors is gathered by the Arduino and sends the sensors information in LCD display.[2] The method for this project, researcher has design the project for the weather monitoring. The researcher uses the Arduino MEGA to control the whole system.

There are three sides-input side and yield side and middle of the road condition of the chart for recognizing the climate. The information sides comprise of DHT-22, Raindrop module, Gas identifying sensor, Barometric weight sensor. For the yield side of this task comprise LCD and another side is called halfway state. In halfway state two things are here, one is Arduino MEGA and another is GSM.[2]

### ***2.2 Weather Station design using IoT Platform based on Arduino Mega***

The researcher creates climate forecast by utilizing IoT stage. With this gadget, clients can know the climate states of a spot by using the web arrange. The point of this venture is work for gathering quantitative information about the climate states of a spot. Separated of that, the specialist attempt to make climate station that can be access through site by utilizing the IoT stage so the client not have to went to the region to know the climate changes. This framework gives continuous information procurement and move of estimated boundary like other significant expense business climate. It is extremely ease, little size, simple utilize and dependable which can be effectively utilized in different applications.[3] Furthermore, the researcher has plan the task utilizing the Arduino MEGA 2560 as a microcontroller. The deliberate climate boundaries incorporate temperature and mugginess utilizing DHT-22 sensors, downpour location utilizing FC-37 downpour sensor, and pneumatic stress utilizing BMP180 sensor.

### ***2.3 JarPi: A low-cost Raspberry Pi based personal assistant for small-scale fishermen***

This research use to help the little scope anglers face different word related security risks because of inaccessibility of constant climate data during the anglers do their exercises during adrift. An ease arrangement called JarPi was created and actualized to fix the issue of the absence of individual right hand for little scope anglers. JarPi is a Raspberry Pi based individual right hand especially intended to help anglers during fishing exercises by giving different data including position which are scope and longitude, separation and course from wind speed, wind bearing, temperature, dampness, and gaseous tension, among different variables.[4] The climate related sensors were associated with a remote transmitter for conveys by means of USB with a remote recipient associated with the Raspberry Pi.

### ***2.4 Arduino based automatic wireless weather station with remote graphical application***

This paper present about the created and tried an equipment module dependent on Arduino Uno Board and Zigbee remote innovation, which quantifies the meteorological information, including air

temperature, dew point temperature, barometric weight, wind speed and wind bearing.[5] Besides, this data is acquired through a uniquely planned application interface that sudden spikes in demand for a PC associated by means of remote Zigbee association. One of the most significant elements impacting the personal satisfaction and human movement is the climate examples and atmosphere conditions. Separated of that, the current methods for metrological information assortment utilize some exorbitant climate stations, bringing about an absence of point by point checking in certain nations because of cost limitations and burden.

## **2. PROBLEM STATEMENT**

Nowadays, deep-sea fisherman face different word related wellbeing dangers because of inaccessibility of ongoing climate data during fishing on the sea.[4] Fishermen routinely work under troublesome conditions. It is normal in this setting to keep fishing during awful climate as long as wellbeing isn't undermined.[6] This is because when fishermen sail in the middle of the sea they have trouble finding internet resources. This will affect the safety of the fishermen while at sea.

One of the main purposes of this project is to reduce the percentage of accidents encountered by fishermen. The reasons for all passing's in British shipper marine and trawler fishing, customarily the two most perilous occupations, were built up for the period somewhere in the range of 1976 and 1995 and contrasted and official mortality measurements for different occupations. Anglers were 52.4 occasions bound to have a deadly mishap at work (95% CI 42.9-63.8), and sailors were 26.2 occasions more probable (19.8-34.7), contrasted and other British specialists.[7] According to statistics above, some of the factors that contributed to the accident were due to the bad weather conditions during the fishermen sailed. In addition, among other factors that have led to increased rates of accidents among fishermen is that they are using outdated technology because they are unable to buy weather forecasts equipment.

## **3. SIGNIFICANCE OF RESEARCH**

For this project it will give benefit of deep sea fishermen where it can reduce the rate of accidents that faced by them. Apart of that, it also can reduce the fishermen burden to spend the high budget for the weather forecasts equipment. Besides, this research also can help the deep sea fishermen in the electronic equipment to identify the weather conditions. Last but not least, this research also can give the opportunity to student to develop satellite weather system for the marine application.

## **4. RESEARCH METHODOLOGY**

Research of the project is very important before the development of the product can be start. This is about to identify the problem statement of this project which is to reduce the rate of accident among the deep sea fishermen and also want to achieve the objective of this project which is to develop a satellite weather system for the deep sea fishermen using the Raspberry Pi and RTL SDR receiver. The research of project is also very important because it can identify and decide what are the best hardware and software that suitable and best to be use for the project.

For the method of collecting data and information, a lot of source can be access and had been referred to. Most of the data and information was from the journal and article in the internet and UniKL MIMET library about the weather station by using Raspberry PI and RTL SDR receiver. Apart of that, the student also referred their project from the previous final year project.

### *Fabrication process*

For this fabrication this project has several stages on the fabrication process:

- I. Setup the Raspberry Pi such as download NOOBS and flash the microSD card
- II. Setup the 3.5 inch LCD display to Raspberry
- III. Assemble the acrylic case to the Raspberry Pi
- IV. Setup the V-dipole antenna
- V. Setup the RTL SDR receiver
- VI. Setup the Raspberry Pi to receive the Automatic Picture Transmission (APT) signal

## 5. RESULTS AND DISCUSSION

Results basically refer to any particular output that come out after finish testing the project or end point that comes as a result of the completion of the activities. For this project, the result of this project can be get based on the quality of the image that has been get from Automatic Picture Transmission (APT) signal from the NOAA satellites. Based on the result that has been recorded for this project, it can be separate by several factors such as the fabrication result, the quality of the image when the V-dipole antenna is ahead to the North for the NOAA 15, 18 and 19, the maximum of degree the V-dipole antenna can be rotate from the North to get the images, and the condition of the image when the weather is raining.

### *Fabrication result*

After finish the fabrication process such as preparing the Raspberry Pi 4 using NOOBS to install the Raspbian, the Raspberry Pi need to be setup with the 3.5 inch touch screen LCD to make it became more portable. After finish the process, the hardware need to be assembled with the acrylic case to protect the hardware. Besides, the V-dipole antenna need to be construct to receive the Automatic Picture Transmission (APT) signal from the NOAA satellites. The RTL SDR receiver dongle that works on SDRSharp needs to be installing to capture the Automatic Picture Transmission (APT) signal. Lastly, the Raspberry Pi need to be setup with the coding to set it to receive the Automatic Picture Transmission (APT) signal when it has been connects with the RTL SDR receiver dongle. Based on the figure below is the result for the project after finish the fabrication process.

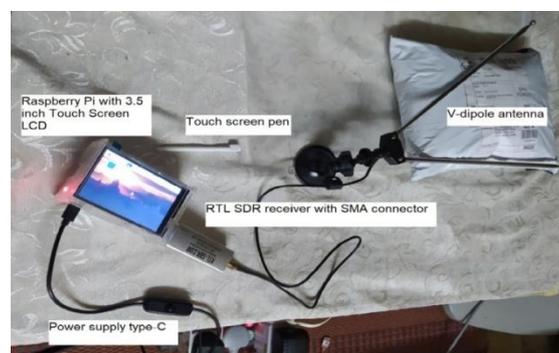


Figure 1. Project after fabrication process

### *V-dipole antenna ahead North*

V-dipole antenna is open with the 120 degree and has been face ahead to the North. The location that has been lock was in the Manjung, Perak. For this result, the image that has been are the NOAA 15, NOAA 18 and 19.

Table 1. Result from NOAA satellites

Type of satellite	Can produce visible image	Can detect current location
NOAA 15	YES	YES
NOAA 18	YES	YES
NOAA 19	YES	YES

### *V-dipole antenna ahead North for NOAA 15*

For the NOAA 15, the date that the result has been capture is 8 October 2020 on the 8.42 a.m and the frequency that has been set from the RTL SDR receiver is 137.62 MHz. The duration for this satellite that passes to the location is about 15 minutes as shown in figure 2.

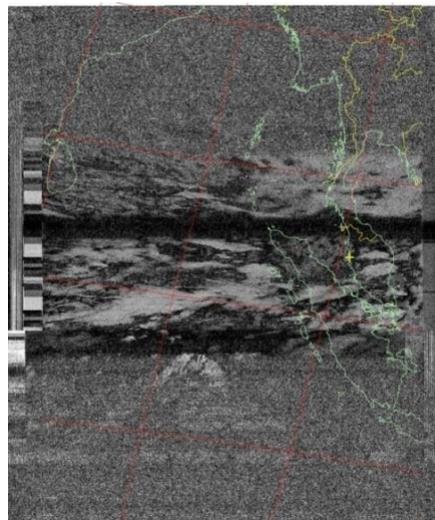


Figure 2. Image from NOAA 15 without filter

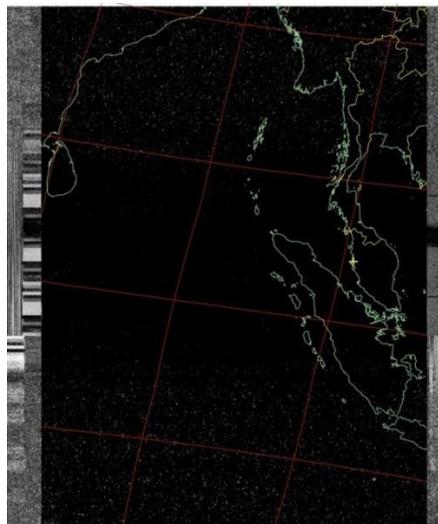


Figure 3. Image from NOAA 15 with Contrast A filter

All the images that has been captured from the NOAA 15 are clear and can be seen. Besides, the location that has been which is Manjung, Perak is the marking yellow spot.

#### *V-dipole antenna ahead North for NOAA 18*

For the NOAA 18, the date that the result has been capture is 9 October 2020 on the 11.04 p.m and the frequency that has been set from the RTL SDR receiver is 137.9125 MHz. The duration for this satellite that passes to the location is about 16 minutes as shown in figure 4.

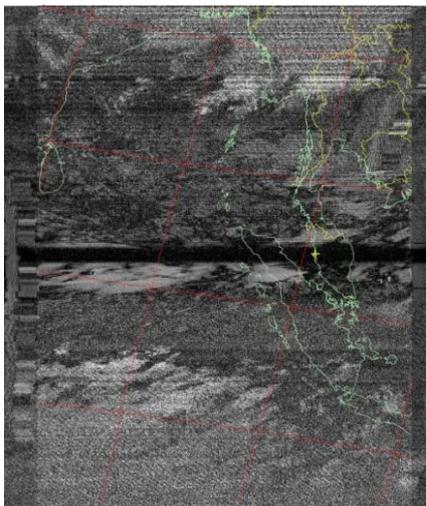


Figure 4. Image from NOAA 18 without filter

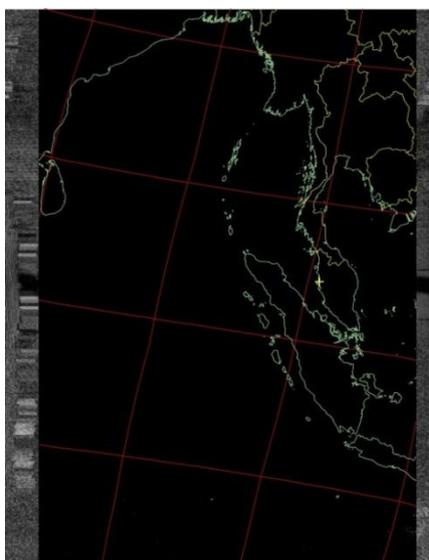


Figure 5. Image from NOAA 18 with contrast a filter

As can seen, all the image that has been capture from the NOAA 18 are clear and can be seen. Besides, the location that has been set which is Manjung, Perak is the marking yellow spot.

#### *V-dipole antenna ahead North for NOAA 19*

For the NOAA 19, the date that the result has been capture is 30 September 2020 on the 7.01 p.m and the frequency that has been set from the RTL SDR receiver is 137.1000 MHz. The duration for this satellite that passes to the location is about 16 minutes as shown in figure 6.

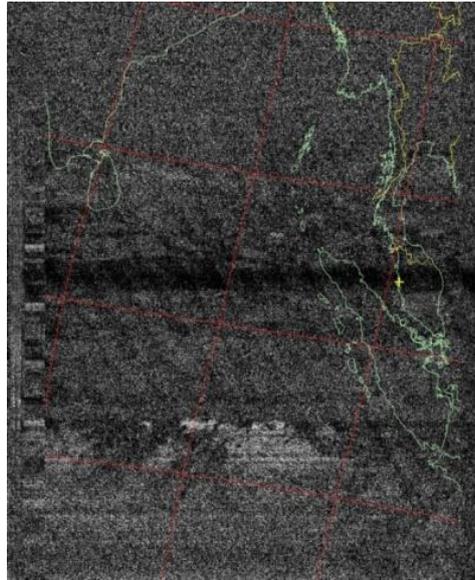


Figure 6. Image from NOAA 19 without filter

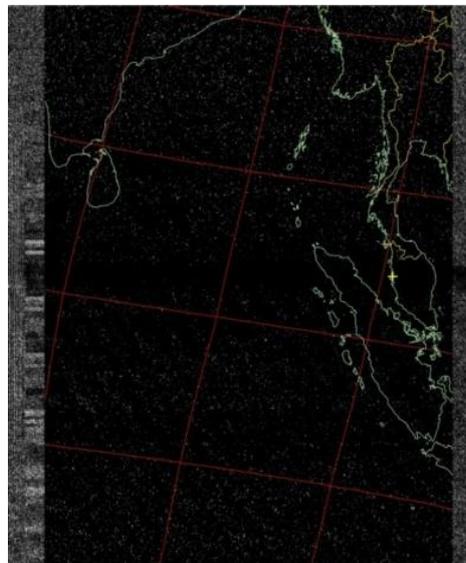


Figure 7. Image from NOAA 19 with Contrast A filter

As can be seen, all the images that have been captured from the NOAA 19 are clear and can be seen. Besides, the location that has been set, which is Manjung, Perak, is the yellow spot.

### ***Maximum • of V-dipole antenna from North***

Based on the result, the V-dipole antenna has been adjusted by different 30 degrees from the North to identify if it can be used to produce the image. The reason for this testing is to know the maximum of the V-dipole antenna that is ahead from the North can produce the satellite image.

Table 2. Result for V-dipole antenna from North

Side of antenna from the North	Degree° of the antenna	Azimuth °	Produce the visible image	Detect the current location
Left	30	330	YES	YES
Left	60	300	YES	YES
Left	90	270	NO	YES
Left	120	240	NO	YES
Left	125	235	NO	NO
Right	30	30	YES	YES
Right	60	60	YES	YES
Right	90	90	NO	YES
Right	120	120	NO	YES
Right	125	125	NO	NO

After set the antenna with 120° ahead the North, the APT signal has been capture and decode to the images. The image from the NOAA satellite cannot be seen but the location that has been set can be detect from the map on the yellow spot as shown in figure below but, the quality of the image become low quality.

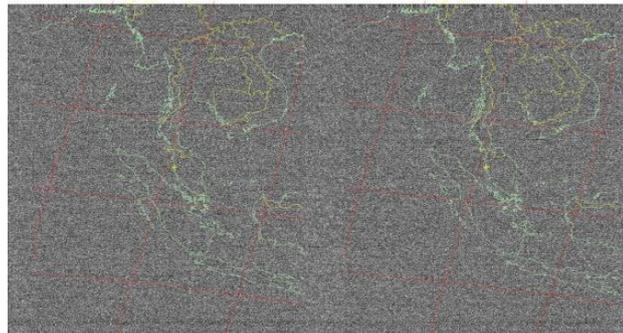


Figure 8. Image satellite 120° from North

After set the antenna with 125° ahead the North, the APT signal has been capture and decode to the images. The image from the NOAA satellite cannot be seen and the location that has been set also cannot be detected from the map as shown in figure below. The quality of the image cannot be see compare to the previous images. The result for this image is called under sampled acquired image.

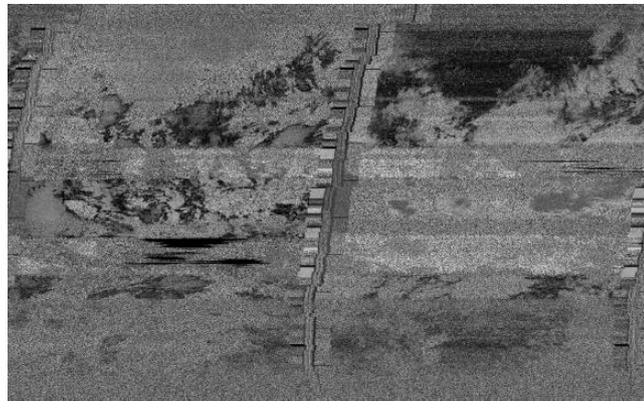


Figure 9. Image satellite 125° from North

### ***Condition of NOAA satellites in rainy condition***

Based on the result, it wants to proof that if this project can be function and use in the bad weather such as rain or not. This is because if this can detect the APT signal and decode into the visible images from the NOAA satellites, it can be more efficient. Based on the result that has been recorded, the V-dipole antenna has been adjust ahead to the North in the rainy condition.

After know the actual time of the NOAA 15 will passes from the location, all the apparatus must be set up first. After finish set up the project, set the frequency of the NOAA and it will auto record the images. Here are the images from the NOAA 15 for the 7 October 2020.

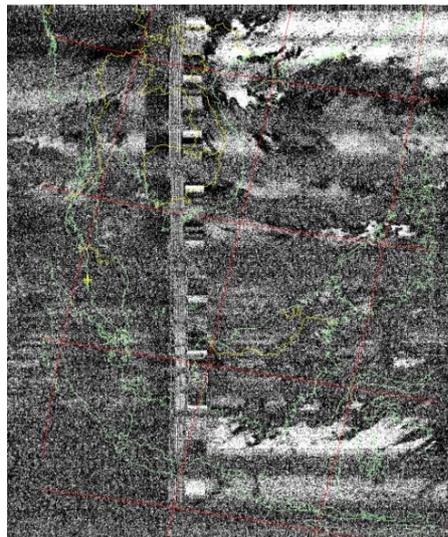


Figure 10. Image NOAA 15 during rain without filter

The complete image that has been captured during rain having a slight interrupted but it can be seen without any problem. Besides, the location that has been set which is Manjung, Perak also can be detected which is the marking yellow spot.

## **6. CONCLUSION AND RECOMMENDATION**

The project is measured to be successful by getting the visible image from the NOAA satellites and the V-dipole antenna ahead to the North. Besides, it is also has been studied to identify the maximum degree of the V-dipole antenna can be turn from the North to get the APT signal to be translating to the visible image. The purpose for this research is to identify the maximum degree from the North that the V-dipole antenna can be turn to get the image. Moreover, the NOAA weather station also can be prove that it can produce the visible image in the rainy condition without having any.

The method to build this Automatic NOAA weather station using the RTL SDR receiver and the Raspberry Pi can help the deep sea fishermen to know the weather condition. Nowadays there are a lot of deep sea fishermen has been risk their life to go to the sea for the fishing activities without know the condition of the weather at the sea, so this NOAA weather station can help the deep sea fishermen to know the condition of the weather because this project does not require the internet sources to get the visible image. It is big advantages that will help a lot in reduce the percentage of the accident from the deep sea fishermen.

For the future works of the potential improvement, some of recommendations has been suggested to improve the features and quality of this project.

- I. The project can be innovated with improvement by adding the sensor for this project such as the temperature and humidity sensor, rain sensor and pressure sensor to detect the temperature and also can detect the rain from the sensor that has been connect to the project.
- II. The project can be repeated by using bigger size of the touch screen LCD for the output to review the visible image for the result clearer.
- III. Use the battery as the power supply to make this project become more portable because it can be place anywhere.
- IV. Redesign the V-dipole antenna using the magnetic concept of the compass to make the antenna automatically turns to North to make it more efficient because it will consist of a magnetized that is allowed to rotate so it lines up with the Earth's magnetic field.

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