Project report on

"Satellite Imagery"

A Dissertation submitted in partial fulfilment of the requirement for the award of degree

MASTER OF COMPUTER APPLICATIONS

OF

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

By

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CERTIFICATE

This is to certify that the dissertation titled "**Satellite Imagery**" submitted in partial fulfilment of the requirements for the degree **"Master of Computer Applications"** by Visvesvaraya Technological University is based on an original study and is record of Bonafede work carried out by **Nilanjan Biswas** bearing university registration number **1BY19MCA29** during the period **April 2022 to June 2022** under our supervision and guidance and that no part of the report has been submitted for the award of any other Degree/ Diploma/ Fellowship or similar title or prizes. The project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the Master of Computer Applications Degree.

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DECLARATION

I NILANJAN BISWAS, student of MCA, BMS Institute of Technology and Management, bearing USN 1BY19MCA29 hereby declared that project entitled "Satellite Imagery" has been carried out by me under the supervision of internal guide Prof. M Sridevi M and submitted in the partial fulfilment of the requirements for the award of Degree of Master of Computer Applications by the Visvesvaraya Technological University during the academic year 2021-22. This report has not been submitted to any other Organization/University for any award of degree or certificate.

Signature

Place: Bengaluru — Name: Nilanjan Biswas

Date: — USN: 1BY19MCA29

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Nilanjan Biswas

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VISION

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PO 2: Identify, analyse and solve IT problems using fundamental principles of mathematics and computing sciences.

PO 3: Design, Develop and evaluate software solutions to meet societal and environmental concerns.

PO 4: Conduct investigations of complex problems using research-based knowledge and methods to provide valid conclusions.

PO 5: Select and apply appropriate techniques and modern tools for complex computing activities.

PO 6: Understand professional ethics, cyber regulations and responsibilities.

PO 7: Involve in life-long learning for continual development as an IT professional.

PO 8: Apply and demonstrate computing and management principles to manage projects in multidisciplinary environments by involving in different roles.

PO 9: Comprehend & write effective reports and make quality presentations.

PO 10: Understand the impact of IT solutions on socio-environmental issues.

PO 11: Work collaboratively as a member or leader in multidisciplinary teams.

PO 12: Identify potential business opportunities and innovate to create value for the society and seize that opportunity.

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CO 2: Analyse the requirements and prepare Software requirement specifications (SRS) document as per IEEE format in consistency with the problem defined.

CO 3: Create models that are consistent with the requirements specified in the SRS.

CO 4: Develop the solution by applying appropriate techniques, software engineering and management principles and modern tools to meet the requirements either as an individual or by involving in team.

CO 5: Verify & validate the data and results to arrive at valid conclusions and communicate the work done effectively in terms of presentations, writing reports and research article as per the format given.

CO 6: Follow ethical principles in all stages of project work by avoiding plagiarism.

CO7: Articulate the impact of IT solutions developed in the project work with respect to societal, environmental and industrial issues at large.

ABSTRACT

Satellite picture handling is a significant area of exploration now a days because of its wide scope of utilizations. Specialists and researchers stand out enough to be noticed to satellite picture handling to catch data from them. Satellite picture examination represents an incredible test to the analysts because of high inconstancy, low goal, and huge information of the satellite pictures. A ton of work has been finished for satellite picture examination that covers the exploration from order of hand created elements to applying superior execution figuring on satellite pictures. The analysts have made incredible progress in satellite picture investigation. In any case, an orderly audit, which will lead specialists to recognize the issue and to contribute to this field, is absent. In the introduced section, an endeavour has been made to introduce an itemized survey of the different strides of satellite picture handling, grouping and accessible data sets. This part will give a force towards additional examination in this field and will give a pattern to investigate in the field of satellite picture handling. Today, Satellite Image Retrieval is a major issue to examine. There is a gigantic measure of exploration work zeroing in on the looking, recovery of pictures in the picture information base. The customary satellite cloud picture search strategy depended on the record name and the sensor boundaries of each picture. The burdens of this technique are that it can't portray the picture substance, for example, shape, shading and so on and furthermore prompts the burden in recovering pictures. This Paper surveys all the methods which could recover pictures from picture data set and furthermore depict the picture substance.

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1. INTRODUCTION

1.1 Project Description

National-Oceanic-and-Atmospheric-Administration also known as NOAA is one of the oldest earths observing organization from USA who currently uses 19 satellites those are used to check the sea and air at a general scale, or we can say it observes the whole global atmosphere. The satellites utilized in this review are NOAA-15, 18 and 19, these three satellites come under the NOAA-LEO range (LEO generally means LOW EARTH ORBIT). At this point, they are in the orbit of the earth to observe the earth by using a picture transmission method, generally known as Automatic Picture Transmission or APT. All the satellites launched are synchronized with the day hours, which are in orbit at a height of 854 km over earth surface. The conveying and getting of APT messages time or schedule for its sort of circle joins in the meantime or hour standard so its game plan is destined during a year. The structure moves a degree without fail to synchronize its circle, and a round trip of the earth moves beyond 1.66667 hours.

The receiving station situated on earth, organized in this examination, is a satellite get-together design to get all the information or the signal from all the 15,18 and 19 NOAA, where the data delivered by the satellites is received. This method includes a formerly dimensioned omni-directional getting wire. The APT signal can easily be decoded by any organization using an SDR, which is basically means or known as Software Defined Radio. In this decoding part the user can use the own antenna or a WEBSDR can be used to get the noise-free-APT.

2. LITERATURE SURVEY

2.1. Existing and Proposed System

2.1.1. Existing System

Accepting we anytime have that disturbing tendency that you are being watched, we presumably won't be misguided. Nevertheless, with our watcher being 423 miles above us, we could battle with approving our instincts. Furthermore, remembering that being spied upon from such a distance could seem like not much detail can be perceived, we might be in for a shock - the GeoEye-1 Satellite, which as of late achieved as the "full useful limit certification from the National Geospatial-Intelligence Agency" (NGA), can get pictures on the ground down to 0.41 meters (or around 16 inches). Geo-Eye guarantees that the GeoEye-1 by and by conveys "the world's most raised objective, most-exact satellite imagery".

The GeoEye-1 Satellite was shipped off last September, and "conveyed its first, full assortment half-meter ground objective pictures" following a month. GeoEye-1 is fundamental for the Department of Defense's (DoD) Next-View program, which "is planned to ensure that the NGA approaches business imagery on its primary objective to give helpful, significant and exact geospatial information in favor of public wellbeing." By financing business satellite development, the DoD ensures that the mechanical advances in satellite and imagery advancement can serve both military and financial matters. Simply military sources, nevertheless, move toward pictures got at the satellite's most prominent ground objective of 0.41 meters; Commercial clients' photos are re-examined at a 0.5-meter objective.

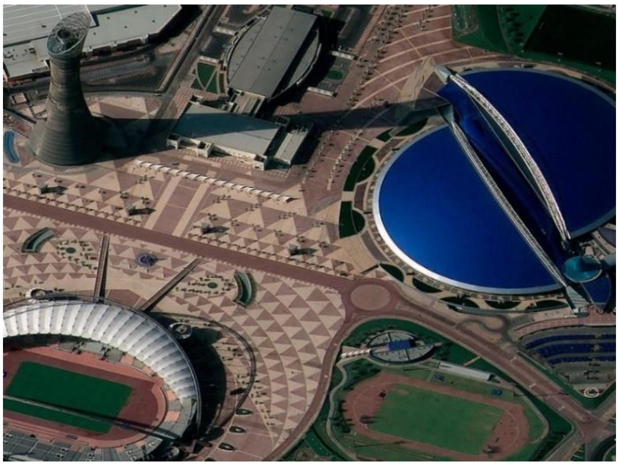

Fig 2.1: HD image of GeoEye-1

2.1.2. Proposed System

In the previous studies there are lots of way to get the satellite data by using some antenna's and then decode the data after resampling but in this paper, we will be grabbing the satellite data by using a simple V-Dipole antenna which is easy to build and accurate in grabbing the data, then we can manipulate the signal according to our need.

- **Creating the antenna (V-Dipole)**

The thought is that by orchestrating a dipole into a level 'Angular' shape, the radiation example will be coordinated skywards in a figure 0 (zero) design. This will be ideal for satellites going in front, above and behind the receiving wire. Since polar circling satellites generally go North to South or the other way around, we can exploit this reality basically by situating the receiving wire North/South.

There is likewise one more benefit to the plan. Since the radio wire is on a level plane enraptured, all in an upward direction spellbound earthbound transmissions will be decreased by 20 db. Most earthbound signs are communicated in vertical polarization, so this can help fundamentally diminish obstruction and over-burdening on your RTL-SDR. Over-burdening is a major issue for some attempting to get weather conditions satellites as they send at 137 MHz, which is near the exceptionally strong FM broadcast band, air band, pagers, and business radio. Interestingly, a circularly enraptured radio wire like a QFH or gate just diminishes upward spellbound earthbound transmissions by 3 db.

As the satellites broadcast in roundabout polarization there will be a 3 dB misfortune in the plan from utilizing a straight captivated radio wire. Be that as it may, this can be thought of as practically irrelevant. Adam additionally contends that the home development of a QFH can never be great, so there will constantly be basically a ~1dB misfortune from mistaken development of these receiving wires in any case.

The last benefit to Adams configuration is that development is incredibly basic. Simply interface one component to the middle cajole guide, and the other to the safeguard, and spread separated by 120 degrees.

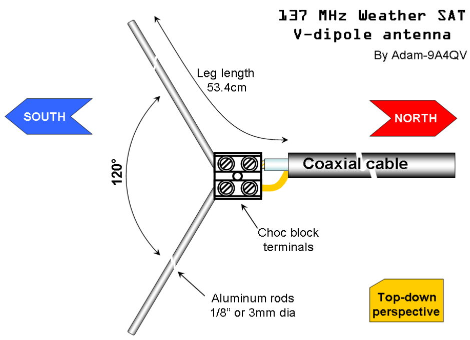

Fig 2.2: Configuration of the V-Dipole

2.2. Feasibility Study

A good grasp of the application is required for a feasible analysis of a python application. Thisstudy focuses on the design and development of a python application to help aspiring python app developers assess the feasibility of a project and improve their knowledge of feasibility analysis. During this process, the feasibility of the project is examined, and strategic plans are produced using an extremely large plan and a variety of quotations. During the framework examination, the success rate of the inspection carried out will be directed. Its purpose is to ensure that the planned program does not place a burden on the consumer. Forthe practicality test, some understanding of the program's key rules is required.

2.2.1. Technical feasibility

A complete review of a python app development project's technical needs, corporate and client preparedness, implementation strategies and roadmaps, legal and cultural concerns, andtimeframe is required. Any architecture should not focus on critical data that can be accessed.As a result, starvation will set in on the most valuable resources available. This would result in the group achieving unprecedented levels of popularity.

2.2.2. Operational feasibility

The developed system is a friendly system where users can share information with individualsor groups. Colleges having their own social media platform has many benefits as data used isstored on their own servers. There will be no leakage of data to third party websites. Data is not used for advertising purposes.

2.3. Tools and Technologies Used

2.3.1. Python

Recent years python is one of the famous and useful programming language that can used in any of the field weather in web development, machine learning or it can on networking. The data structure in this language has been built on high-level with the combination of two special things dynamic typing and dynamic binding which is very fast and efficient for RAD (Rapid Application Development). Being a OPPs (Object Oriented Language) language, it's very easy to learn compared to other language like C++ and JAVA because the syntax of this language is like a normal English language. Python has modules and packages support which make coding easier for users to import files and packages which is useful for code reuse. The interpreter and the standard library available for both source or binary which are executable in any major platforms and the main thing of this language is it's totally free.

In the year 1980s where the journey of python started and it's invented by Guido van Rossum, Python is platform friendly and open source which means anyone can be a contributor for the official library of python just he/she needs to be a developer.

Developers often use this language on any of their projects because the compiler is platform friendly and easy to configure. Debugging in python is easier compared to any other OOPs programming language but while showing the error it throws a stack trace where a small explanation is there about the error along with the line number. Now after fewer updates python is coming up with a small editor call Python IDEL, which is light weight editor which allows developers to edit their errors.

2.3.2. Wxtoimg

WxtoImg is the ultimate APT as well as WEFAX satellite signal decoder and the main part is it's fully automatic. This decoder is used to decode an APT signal of a weather satellite, but it's specially built for NOAA satellites (NOAA-15, 18and 19) APT decoding. This particular satellite decoder is platform friendly for all major OSs like Windows, Linux, Unix and MacOS. The main or one of the unique features of this decoder is that it can decode signal real-time directly while fetching without resampling the signal but for real-time decoding we need our own V-dipole antenna.

2.4. Hardware and Software Requirements

2.4.1. Hardware Requirements

Components	***Specification***
Processor/CPU	Intel Core i5-8400
HDD	5 GB SSD
Monitor/Screen	Standard RGB
Pointing Device	Standard Mouse
Memory/RAM	8 GB

Table 2.1 Hardware Requirements

2.4.2. Software Requirements

Components	***Specification***
Operating System	Windows 10 64-bit /macOS 10
Programming language	Python
Software	WxtoImg, apt-decoder, audacity.

Table 2.2 Software Requirements

3. SOFTWARE REQUIREMENTS SPECIFICATION

A software requirement specification is required to obtain a sense of the overall design that is being created, as well as the resources required. This paper explains how the system works. The non-practical and practical needs of the program to be created are defined in the software requirements specification. It also shows some of the pieces needed to establish a toolenvironment, improve the discovery process, and so on.

3.1. Users

Users are the key consumers of the program thus they play a crucial part in it. To utilize the program, the user must meet specific requirements, which are detailed here. Usersare the consumers and suppliers of the data fed into and by the system, therefore they are the backbone of every program.

3.1.1. Scope and Objective

To be able to analyze in the tool, the user must be able to get the required data as an image after decoding the APT signal received from the satellite. As the satellite sends the weather data, by the help of the image data we can analyze the image as the it is a stormy image or it’s a clear sky image.

3.1.2. Assumptions and Dependency

It is assumed that all the users have their own V-Dipole antenna. Then they can start fetching the satellite APT signal and decode in real-time using the SDR software. After a successful fetch they can pass those images into the machine learning model for the analysis of the stormy sky or a clear sky. As an out of the APT signal, we get the clear image of the earth surface real time, and the second out is the analysis of the clear sky.

3.2. Functional Requirements

The functional requirements for each of the application's components are mentioned below.

3.2.1. User

Requirement ID	Requirement feature	Description of Requirement
FR1	Signal fetch	By using the antenna, fetching the signal APT signal can be done.
FR2	Resample APT	Before decoding the image, user can resample the .wav APT file in 11025 sample rate to get the sync frames.
FR3	Image Decode	Now the resample wav file can be decoded to get the final image.
FR4	Analyzing the images	This module is to analyze the out image after decoding. So, it will tell whether it’s a clear sky or stormy sky.

Table 3.1 Functional Requirements for Lecturer

3.3. Non-Functional Requirements

Requirement ID	Requirement feature	Description of Requirement
NFR1	Essential Execution	Essentiality of production aids in deciding the tool's tolerant framework properties for reacting to production
NFR2	Safety Requirements	To operate and keep data safely in the database forever, the tool must adhere to all necessary security procedures. Any data loss will be costly to the company.
NFR3	Security Requirements	The created tool must fulfil all the standards set out by the regulatory body. For data transport, all protocols and algorithms must require secret keys.
NFR4	Approachability	The tool must be hosted in a safe environment to satisfy the customer's requests for access. There will be no delays or application hang-ups.
NFR5	Standard Quality	The tool is being created with all development standards in mind. Standard service can be provided using the tool. Our structure will not fail.
NFR6	User Friendly	The tool was created with all the clients in mind. As a result, the tool is basic and straight forward to use. To use the program, you only need a basic understanding of digital technology.

Table 3.2 Non-Functional Requirements

4. SYSTEM DESIGN

4.1. System in Detail

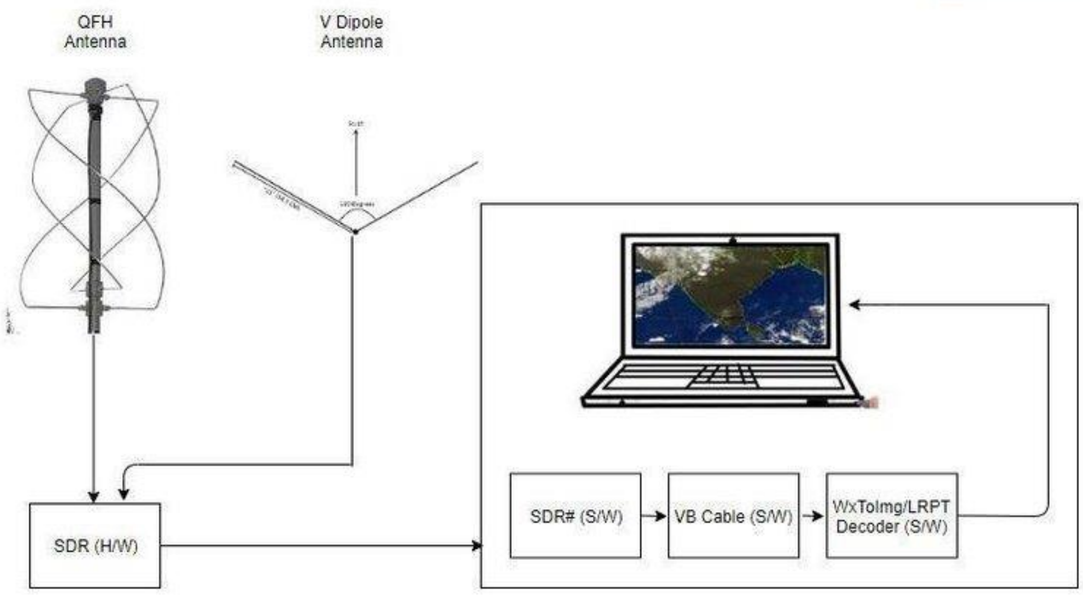

Fig 4.1: Work-station workflow

Figure 4.0 shows, the periods of the stations present on the planet. The chief stage consolidates a radio wire, which is organized in a system Double Dipole Cross receiving wire, that is an omni-directional structure which fundamentally decreases the obscuring that makes signals from satellites at the same time the layers of the demeanour of earth.

The V-Dipole or the Antenna Double Cross is a radio wire used for getting signals from meteorological satellites NOAA. Its radiations have an incorporation district of a half circle that allows an optimal following presentation. The radio wire has standard characteristics, for instance, four dipoles with a half recurrence related in a phenomenal way to create the isotropic-radiation diagram.

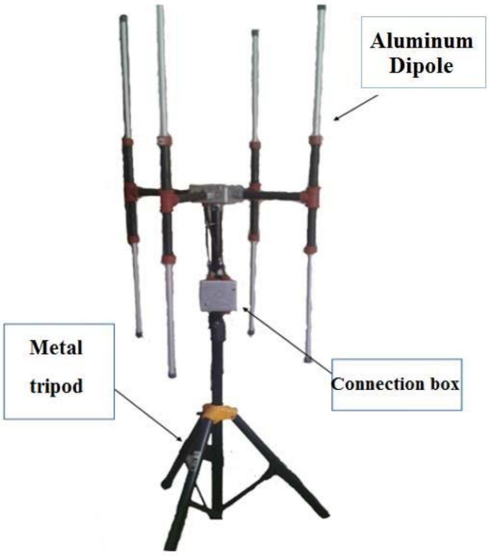

Fig 4.2: This is a Double Cross Dipole Antenna

The demeanour of the radio wire dipoles affiliations is to be focused with the coaxial aide. Accordingly, in the getting wire two dipoles are adjusted with 90° practically identical to the following arrangements of dipoles. This is achieved with a relationship of a line in a fourth of recurrence more conspicuous among different arrangements of the dipoles coordinated with the getting wire.

The coaxial wires are estimated in items frequencies, similar with the speed of light from the essential wire, endeavouring that the offset gets least, with the line coupling the radio wire.

$$Coaxial\ cable\ L. = \frac{c \cdot sf}{f} * n\ meters \qquad (1)$$

Coaxial-cable L. = coaxial cable length, c= light speed, n = integer, f = frequency.

Sf = Speed factor (it’s totally depending on the cable that we are using)

For test, we need to enter the veritable assessments and loses factor with the objective that the item can translate better the genuine radiation illustration of the ADC.

Estimations related with the social event impact, difficulties and EIRP were performed by the overall conditions that are necessity next.

$$EIRP = Pt - L + G\ (dBm) \qquad (2)$$

The EIRP can connect with the influence conveyed from the radio (Pt), the connection hardships (possibly including getting wire fumble) L, and the getting wire gain (G).

$$RxLev\ (dBm)\ =\ EIRP\ (dBm)\ -\ Path\ Loss\ (dB) \qquad (3)$$

$$Path\ loss\ (dB)\ =\ 32.4(dB)\ +\ 20log\ [\,f(MHz)]\ +\ 20log\ [\ d\ (km)] \qquad (4)$$

As shown by calculations 16 dB gains is gotten at the station less 13 dB for the sign to be decodable it gives a value of 3 dB giving a good increment for signal get-together.

4.2. What is an APT?

APT is abbreviated as Automatic Picture Transmission which is nothing but a method or we can say an algorithm to transfer images taken by a satellite or by a weather satellite. This specific algorithm/system was built in the year of 1960s and in past few decades this method has been providing the image data to relatively low-cost to the stations situated in different parts of the world. The data or image data transmitted as APT can be received by and person or organization having a V-dipole or a strong antenna with the frequency range of what the satellite transmits.

4.2.1. Structure

The image data which is received from the satellite are produced using two picture station it contains the telemetry information and the sync data / synchronization data, then the image is extract from two channels video, one is Video A, and the other is Video B within a range of an even bit line. The line / the complete line consists of 2080 pixel and the pixel size of each image is 909 pixels with telemetry and synchronization. Each line is imparted accordingly 2 each second, containing max 4160 words or 4160 baud.

4.2.2. Characteristics of the Images

On the framework of the NOAA satellites named POES, each of the pair of pictures are 4 km/pixel clear/blur less 8-cycle pictures got from the telemetry and the synchronization stations of the incredible level extremely huge standard sensor knows as or named as AVHRR which is basically a radiometer sensor. The photographs adjusted for essentially solid mathematical objective preceding being conveyed; thusly, the photographs are liberated from bending accomplished by the cadenced development for the future of the whole globe.

Among two of the received pictures, the first is usually contains the infrared images by infrared waves of 10.8 micrometres which are broadened with the subsequent exchanging among the close distinguishable which is 0.86 micrometres and the infrared which is gathered form the mid-wave is 3.75 micrometres subject to whether the ground is illuminated by daylight.

4.2.3. Synchronization data and telemetry data

The data which is transmitted by the satellite are send by maintaining the synchronization bits along with the telemetry data and the minute markers.

The synchronized or we can say synchronization data, passed close on to the beginning of each video channel, permits the getting programming to change it attempting to the baud speed of the sign, which can differentiate reasonably for quite a while. The subsequent markers are four lines of turning faint then, at that point, white lines which repeat at standard stretches about lines of 120.

The segment containing the telemetry is produced using the blocks of 16 where each line defines the length of eight (8) that can be utilized as reference values so that it can be disentangle the picture stations. The eight blocks known as wedge start at the max power of 1/8 those are consistently increases with the full power of 1/8 by minimum eight wedge, considering the zero power being 10th. Among fifteen ten blocks are considered in each encode with a course of action a catalyst so that the sensor can perform its task efficiently and the 16th (sixteenth) block perceives which sensor can be used for the fundamental picture channel where the power of one of the wedges one through six should be matched where channel A containing the Video wedge a couple supposed to be matched, channel B matches wedge four.

The fourteen fundamental blocks generally its hazy for the two channels. The rehashing is done with the sixteen clear blocks telemetry within 128lines after that those 128 lines are bundled to produce the image.

4.2.4. Broadcast signal

The veritable sign or the signal is a 256-level which is good quantity according to the range of subcarriers and the value is 2400Hz that is further rehashed onto the 137 MHz-band RF transporter. Most breaking point subcarrier change is 87% positive or negative to 5% and in general RF data transmission is 34 kHz. On NOAA vehicles those are having the POES modules those signs are granted at commonly 37dBm which means 5 watts, rate the signal should be transmitted.

4.3. Overview Of APT Signal

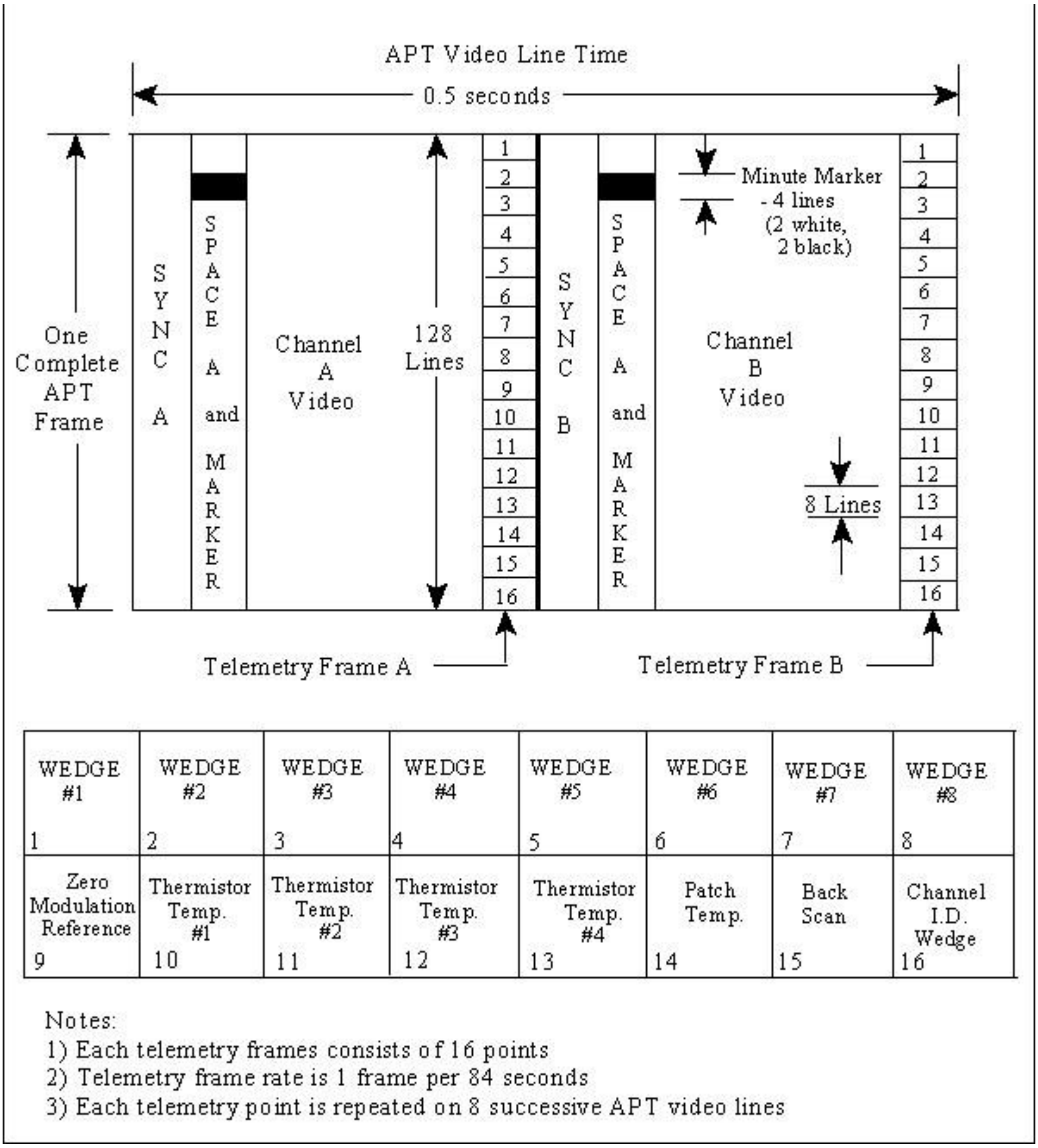

Fig 4.3: APT Transmission Format

4.4. Data Flow Diagram

4.4.1. Level 0 – DFD

The most significant aspect of utilizing data flow is to figure out how data travels across the system. Every tool's data is an asset and keeping it up to date necessitates appropriate tracing.

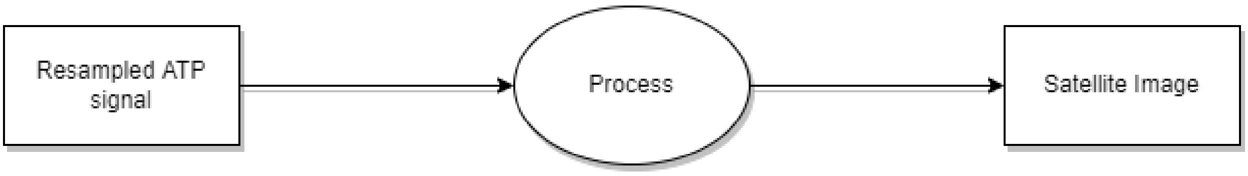

Figure 4.4: DFD Level -0

4.3.2. Level 1-DFD

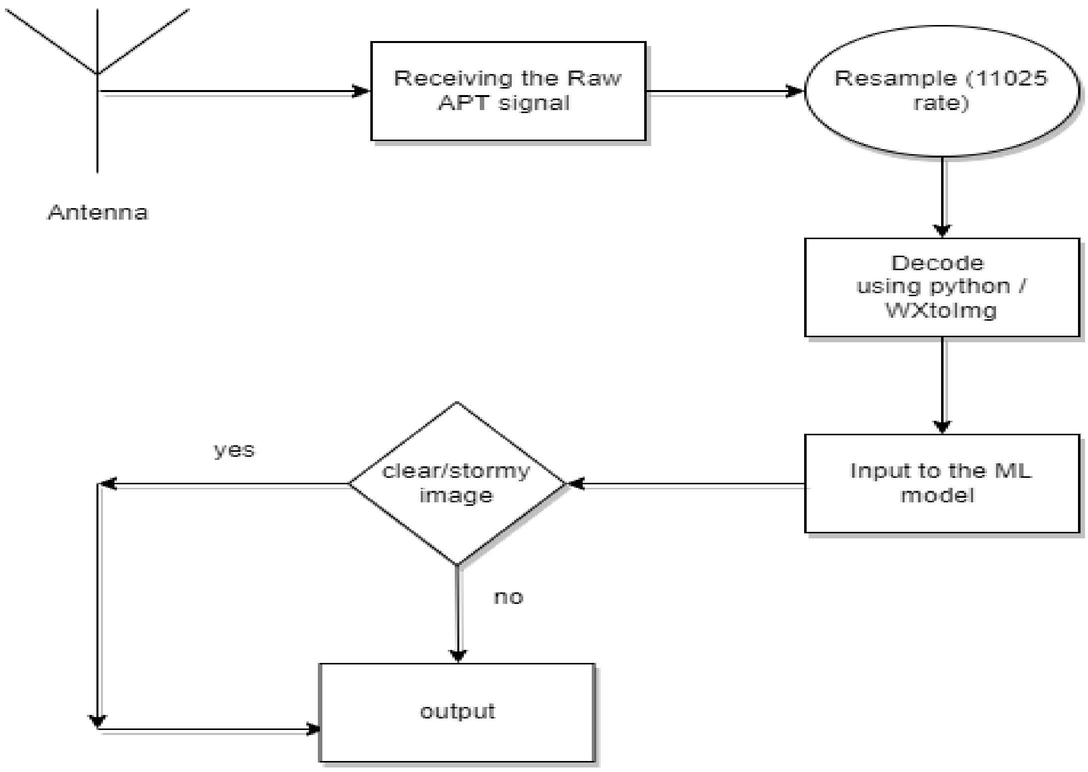

Fig 4.5: Level 1-DFD

5. IMPLEMENTATION

5.1. Code Snippet

5.1.1. resample/decode.py

```
# import scipy.io.wavfile as wav
# import scipy.signal as signal
# import numpy as np
# import matplotlib.pyplot as plt
# from PIL import Image
# import cv2

wav_path=r'wav_audio\NoAA15_apt_nf_30.05.2022.wav'

fs,data=wav.read(wav_path)

plt.figure(figsize=(12,4))
plt.plot(data)
plt.xlabel("Samples")
plt.ylabel("Amplitude")
plt.title("Signal")
plt.show()

def helbet(data):
    analytical_signal = signal.hilbert(data)
    amplitude_envelope = np.abs(analytical_signal)
    return amplitude_envelope

data_re=helbet(data)

"""frame_width = int(0.5*fs)
```

```
w, h = frame_width, data_re.shape[1]//frame_width
print(h)
image = Image.new('RGB', (w, h))
px, py = 0, 0
for p in range(data_re.shape[0]):
    #print(p)
    lum = int(data_re[p]//10 - 10)
    if lum < 0: lum = 0
    if lum > 255: lum = 255
    image.putpixel((px, py),(lum))
    px += 1
    if px >= w:
        if (py % 50) == 0:
            print(f"Line saved {py} of {h}")
        px = 0
        py += 1
        if py >= h:
break"""

def getImageArray(self,am_envelope, norm):
     print("Processing image...")

     #calculate the width and height of the image
     width = int(self.sampling_rate*0.5)
     height = self.am_envelope.shape[0]//width
     print(f"width: {width}, height: {height}")

     #create a numpy array with three channels for RGB and fill it
up with zeroes
     img_data = np.zeros((height, width, 3), dtype=np.uint8)
```

```
    #keep track of pixel values
    x = 0
    y = 0

    #traverse through the am_envelope and replace zeroes in
numpy array with intensity values
    for i in range(self.am_envelope.shape[0]):

        #get the pixel intensity
        intensity = int(self.am_envelope[i]//norm)

        #make sure that the pixel intensity is between 0 and
255
        if intensity < 0:
            intensity = 0
        if intensity > 255:
            intensity = 255

        #put the pixel on to the image
        img_data[y][x] = intensity
        x += 1
        #if x is greater than width, sweep or jump to next line
        if x >= width:
            x = 0
            y = y+1

            if y >= height:
                break
    print("Image processed.")
    cv2.imshow('image',img_data)
```

5.1.2. main.py

```
# from tensorflow.keras.layers import
Conv2D,Flatten,Dense,MaxPool2D,BatchNormalization,GlobalAveragePo
oling2D

# from tensorflow.keras.applications.resnet50 import
preprocess_input,decode_predictions

from tensorflow.keras.preprocessing.image import
ImageDataGenerator

# from tensorflow.keras.preprocessing import image

# from tensorflow.keras.applications.resnet50 import ResNet50

# from tensorflow.keras.models import Sequential

# from tensorflow.keras.models import Model

# from tensorflow.keras.optimizers import RMSprop

# import matplotlib.pyplot as plt

# import tensorflow as tf

# import numpy as np

# import cv2

# import os


img_h,img_w=(224,224)

batch_size=32

f=r"train\clear_dataset\1.jpg"

img=image.load_img(f)

im=cv2.imread(f).shape

print(im)

train=ImageDataGenerator(rescale=1/255)

validation=ImageDataGenerator(rescale=1/255)

train_dataset=train.flow_from_directory('train/',target_size=(200
,200),batch_size=3,class_mode='binary')

validation_dataset=train.flow_from_directory('validation/',target
_size=(200,200),batch_size=3,class_mode='binary')

p=train_dataset.class_indices
```

```
print(p)

model=tf.keras.models.Sequential([tf.keras.layers.Conv2D(16,(3,3)
,activation='relu',input_shape=(200,200,3)),

                                tf.keras.layers.MaxPool2D(2,2),
tf.keras.layers.Conv2D(32,(3,3),activation='relu'),

                        tf.keras.layers.MaxPool2D(2,2),
tf.keras.layers.Conv2D(64,(3,3),activation='relu'),

                                tf.keras.layers.MaxPool2D(2,2),
tf.keras.layers.Flatten(),
tf.keras.layers.Dense(512,activation='relu'),
tf.keras.layers.Dense(1,activation='sigmoid')
])

print(model)

model.compile(loss='binary_crossentropy',optimizer=RMSprop(learni
ng_rate=0.001), metrics=['accuracy'])

model_fit=model.fit(train_dataset,steps_per_epoch=3,

epochs=30,validation_data=validation_dataset)

print(model_fit)

input_path='imput_images'


for i in os.listdir(input_path):

    inp=image.load_img(input_path+'//'+i,target_size=(200,200))

    plt.imshow(inp)

    plt.show()

    X=image.img_to_array(inp)

    X=np.expand_dims(X,axis=0)

    images=np.vstack([X])

    val=model.predict(images)

    print(val)

    if val==0:

        print("clear_data")

    else:

        print("Storm_Image")
```

5.2. Screenshots

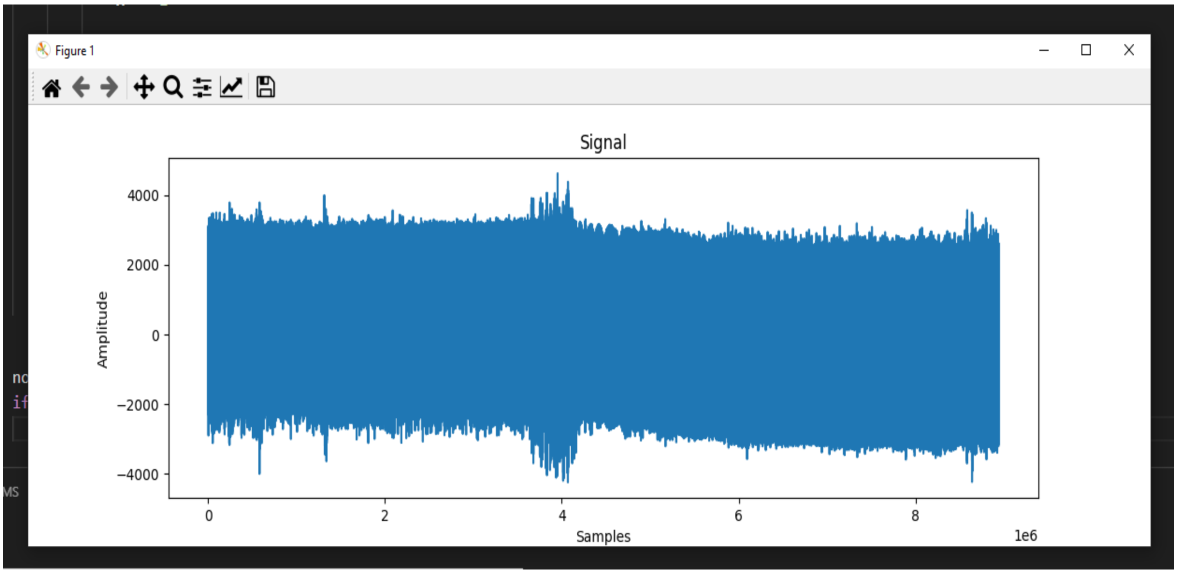

Fig 5.1: This is the output for the resample APT signal

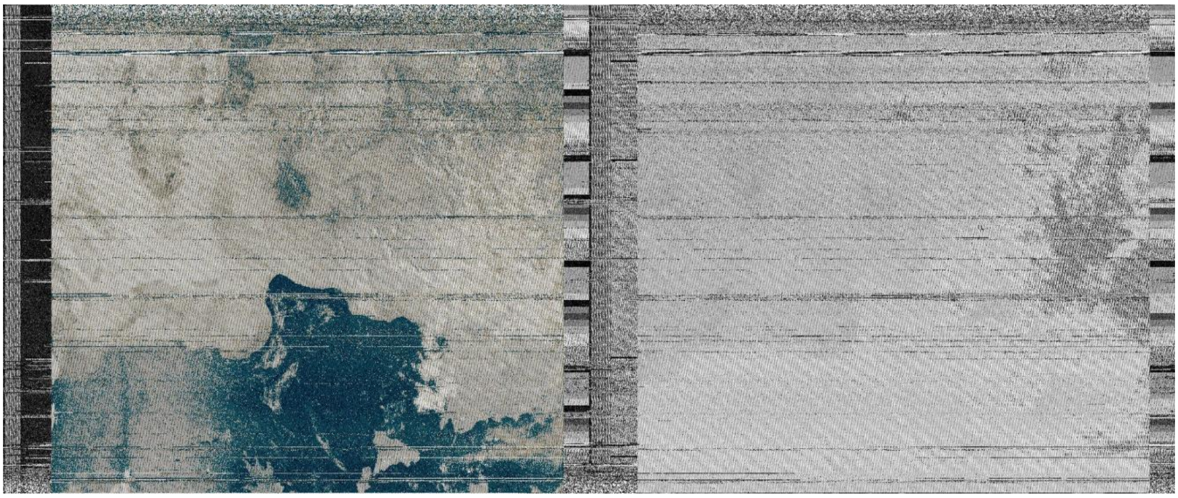

Fig 5.2: The output for the decode APT signal (the true-colour image)

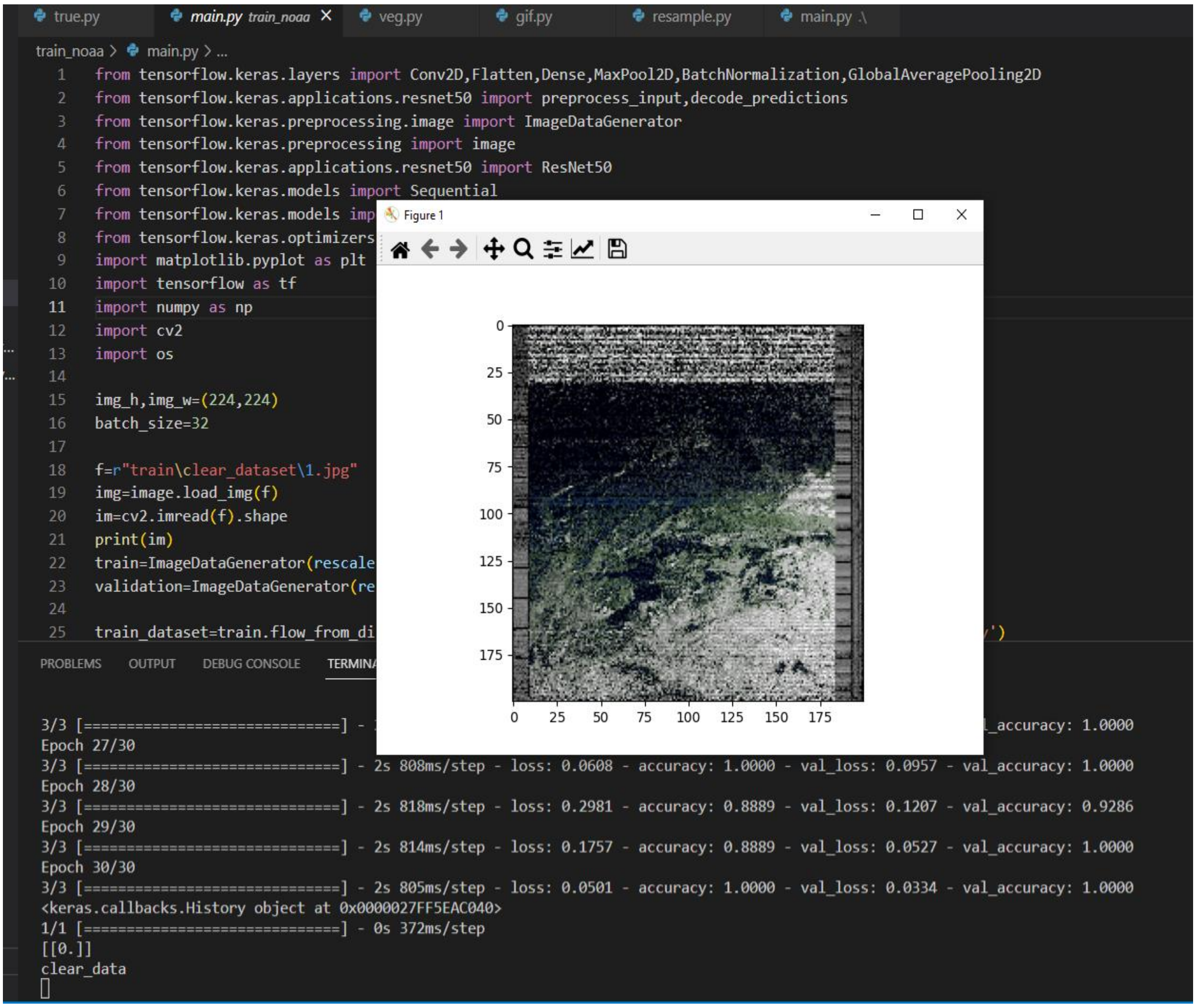

Figure 5.3: The prediction for the image.

6. SOFTWARE TESTING

6.1. Introduction

Testing is a phenomenon that is used to detect faults and bugs in software that have occurred or may arise in the future. It also provides information on the product's quality, such as the system, software, and so on. In software testing, software developers run programmers to lookfor flaws or faults in the system. Software testing ensures that the system meets its specifications. It keeps track of all the system's intended outcomes and outputs, providing a comprehensive picture of the project's quality. It also examines the system's practicality, suchas its timeliness, cost, and other factors. This App has been thoroughly tested to identify any flaws, and they have been corrected. When an error happens during a certain operation, the App may fail to detect any of the faults. The App is assessed by supplying both valid and improper inputs and how the application will be reviewed for the faulty inputs, as the goal of conduction is to find defects.

6.1.1. Unit Testing

Unit testing entails the creation of test cases to determine whether the program's inner code is performing correctly and producing legitimate outputs. The internal flow of code and all decision branches have been examined. This is done by the developer himself to check the program's code flow. After each individual component of this application has been constructed, it is tested to identify any problems that may cause the system to fail.

6.1.2. Integration Testing

After all the components have been integrated, integration testing is done to look at how well they work together and how well they synchronize data. Once the application's modules(Admin and User) are merged, the interaction between their components is tested. It examines the data synchronization between these modules. The data synchronization across all modulesis flawless. The interplay of the modules results in the desired application output. The inclusion of these modules has no effect on the modules' functionality.

6.1.3. Functional Testing

Functional testing is used to see if all the features are working as they should or if they aren't. This framework is examined by supplying various inputs and observing the output for all functionalities. The application functions correctly and provides the expected outputs in accordance with the right specifications, and all requirements are met. The application is designed to display warning messages for any erroneous inputs, assisting users in providing valid inputs. During testing, several flaws are discovered and repaired.

6.1.4. System Testing

System testing is done to ensure that the entire software meets the required standards. It's a configuration testing mechanism that ensures predictable and consistent outcomes. System testing can be done based on the setup of the system. This type of testing focuses on process flows and definitions, as well as process links with pre-driven processes. System testing makesit easier for all the components of a program to interact. The reason for the proper functioning of the separate modules is because each unit has its own pre-defined functionalities. Each module communicates and transfers data across modules and throughoutthe system by interacting with one another.

6.1.5. Acceptance Testing

Acceptance Testing is a type of functional and performance test in which the application is checked for the correct output given the correct inputs. The internal structure of the system orits components are not tested in black box testing. The major goal here is to see if the application's requirements are being satisfied. Regression testing is useful for determining howan application will function after a few modifications have been made and for identifying andcorrecting mistakes. After resolving the issues, the program behaves as intended; the changes made have no effect on the outputs of other functionalities, and the application provides the functionality expected. For all valid inputs, the outputs are correct.

6.2. Test Cases

6.2.1 User

Test case Id	01
Test name	Unit Testing
Tested feature	Resampled wav APT signal.
Tested feature	Decoding the image.
Tested feature	Storm Prediction.
Expected Outcome	The output of the image as stormy or clear in the console.

Table 6.1 Unit testing for user

7. OPEN ISSUES AND FUTURE WORK

7.1. Expanded Spatial and Temporal Coverage and Resolution of Satellite Observations

Tremendous benefits that we can get from remote sensing with the help of any type of satellite is to cover lager regions of the globe as well as the places that is not humanly possible to reach. Simultaneously, thought impediments of at present open satellite information are also self-evident. As an example, we can take a module in the satellite called polar-imager which generally takes photo of the climate's changes of our earth's poles, this module comes under the LEO-Low Earth Orbit, and it takes at least a day to gather information's about the earth (might take two days). In this way the high circle stations which are situated on earth receives the accurate data for further testing. After the proper data or information being collected it generally contains both spatial-normal extensive and the high spatial information's which can be used on many types of applications and analysis, yet moreover remarkably testing. In this manner, the game plan of satellite observations could require new developments, subordinate information, and supportive energies of free experiences to address express articles and material issues. This is talked about additional in the going with district.

7.2. Expanded Information Content and Exploring Synergy of Observations

Be that as it may, the high furthest reaches encounters of the satellites that have been obviously filed, relentless information given by the instruments that are functioning in the satellites does not have that much content or limited information, indeed application. Along these lines, the relationship of new sensors with extra made limits is drawing in and composed. For instance, it provided the MAP module or the Multi-Angular Polarimeters give the most fitting information to portraying point by point columnar properties of barometrical shower and cloud. So, the thought on polarimetric information in sprinkle and cloud portrayal should from an overall perspective expansion in the going with decade. A couple progressed some missions which are also known as polarimetric-missions which/those are needed to be transported off in generally couple of years by the combination of both United States and Europeans space affiliations including Multi-View Multi-Channel Multi-Polarization Imaging mission or abbreviated as 3MI on a satellite formally named as MetOP-SG and with a special module implementation known as MAIA, stands for Multi-Angle Imager for Aerosols instruments.

The Spectropolarimeter for Planetary Exploration or Spex and HARP also known as Hyper-Angular Rainbow Polarimeter these modules are introduced by NASA during the PACE mission, Multi Spectral Imaging Polarimeter (MSIP)/Aerosol-UA, MAP instruments is introduced as a component and implemented on Copernicus CO2M Mission by the European Space Agency and so on. In this way, the CNSA or China National Space Administration has commonly positioned resources into polarimetric sensors. CNSA has delivered off some of the innovative and efficient polarimetric remote perceiving instruments consists of the TG-2 (MIA), Tan-Sat (CAPI), GF-5 (DPC) and SMAC/GFDM and the next plane is to descend the POSP, PCF, DPC-Lidar modules soon to replace them with some advanced modules. The efficiency check and the consideration of these modules, their arrangements, and the assessment movement been really examined and texted including airborne models as dissected in 2019.

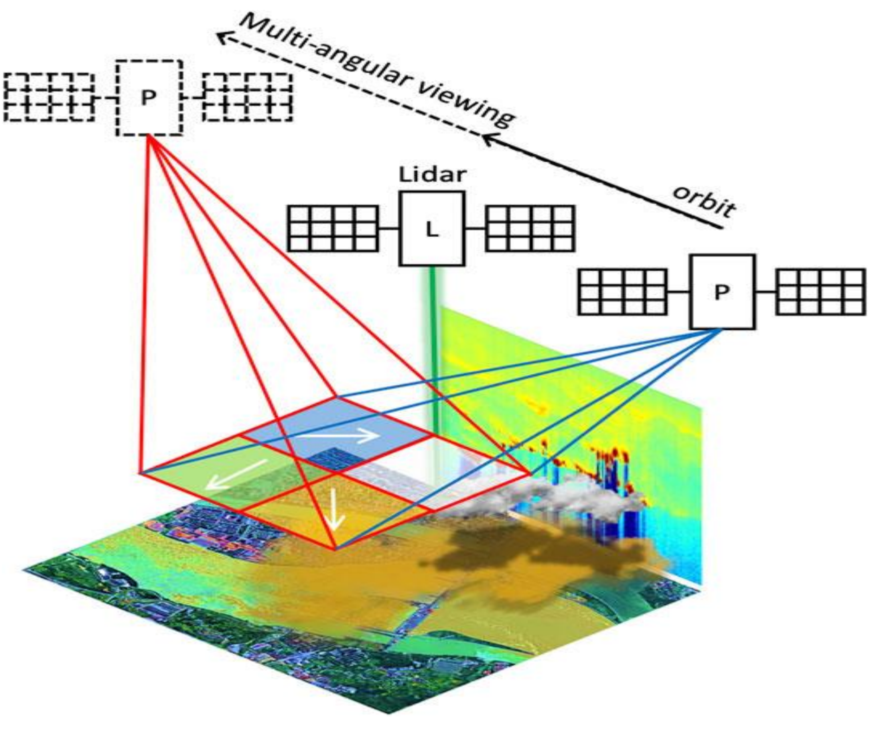

Fig 7.1.: The lidar and MAP instrument combined observations to provide 3D characterization of the atmosphere.

7.3 Improvement on processing the Data on State-Of-Art for the Next Generation

Possibility of a recognizing using remote sensing recovery assessment is one more principal viewpoint that influences the possibility of the inescapable outcome. Truth be told, when the instrument has been conveyed, the idea of the subsequent observational information can't be from an overall perspective improved, while recovery calculations stay under unsurprising improvement. The last remote perceiving thing can be prominently fascinating not just due to ingesting information from various instruments, yet moreover by virtue of upgrades of recovery contemplations. In such manner, the new time of remote distinctive recovery calculations has progressed overall in the previous 10 years. For instance, new calculations will generally depend on quick and precise climatic appearance (rather than utilizing Look-Up-Tables/LUT which are generally precomputed) and these are one of the great for recovering endless cut-off points. Moreover, synchronous recovery of shower properties closes by the properties of the land surface or conceivably properties of the clouds have been executed. At long last, inside the development of the CO2M EU/Copernicus examined over, the recovery of CO_2 and sprinkle properties working eagerly together that is a framework which is trusted and promising for reducing the impact of shower tainting on the best or most appropriate among CO_2 things.

7.4 Accomplishing Continuity in Consistent Satellite Observations and Long-Term Data Record

A significant length and fantastic record of pivotal environment factors is fundamental for seeing and focusing on changes in the climates of the Earth. A fundamental condition for accomplishing this objective is the development of the experiences, which should be maintained and check about the data that should first class data grouping and while in the middle of the process there should not be any break in between the grouping. Regardless, openings in a data record gathered by the multi-instrument module of the satellite, can't be true to form unravelled, and the worth of the satellite record almost vanishes.

Subsequently, the total change of each instrument and the synchronization or the intercalibration of different critical instruments/sensors stays fundamental to get the accurate result in essentially all targets of satellite remote recognizing and adjusting lot of instruments is attempting, especially for groupings of little satellites, these types of groupings are known as Star-Grouping. National Academies of Sciences, Engineering, and Medicine in 2015 they have introduced the necessities for staying aware of broadened length insights, the mission named CLARREO is one of their first undertaking to depict a satellite mission devoted toward this objective. Like the change of direct insights, the detectability and consistency of the new to the scene period of satellite things to the present-day instrument suite is fundamental.

8. CONCLUSION

Satellite imagery is indeed a powerful tool to explore especially in urban planning.

Although we are still experiencing certain limits and biases in using satellite imagery as a tool in urban planning and design, there is no doubt that the possibilities could be endless. It is just a matter of knowing the right procedure to use. Who knows, maybe in the future there will be what we could call, “microscopic satellite imagery”.

Thus, we can draw an important conclusion: satellite images are extremely useful in the study of urban patterns and natural resources. Using several programs, including python and qgis, you can process satellite images using graphical indicators (NDVI, NDBI, NDWI, etc.) as a result, researchers can make meteorological forecasts, study solar radiation, atmospheric phenomena, analyse the state of soils and flora, water resources, and so on.

Based on high-quality data obtained using satellite images, specialists from various fields have the opportunity to create effective strategies to solve current problems: global warming, water and soil pollution, the deterioration of the Earth’s atmosphere, etc.

We would like to believe that in the future, with the further development of technologies and improved monitoring of the state of the Earth, it will be possible to mitigate the consequences of global disasters, forget about the problem of hunger and make people’s lives much better and safer.

9. OUTPUT

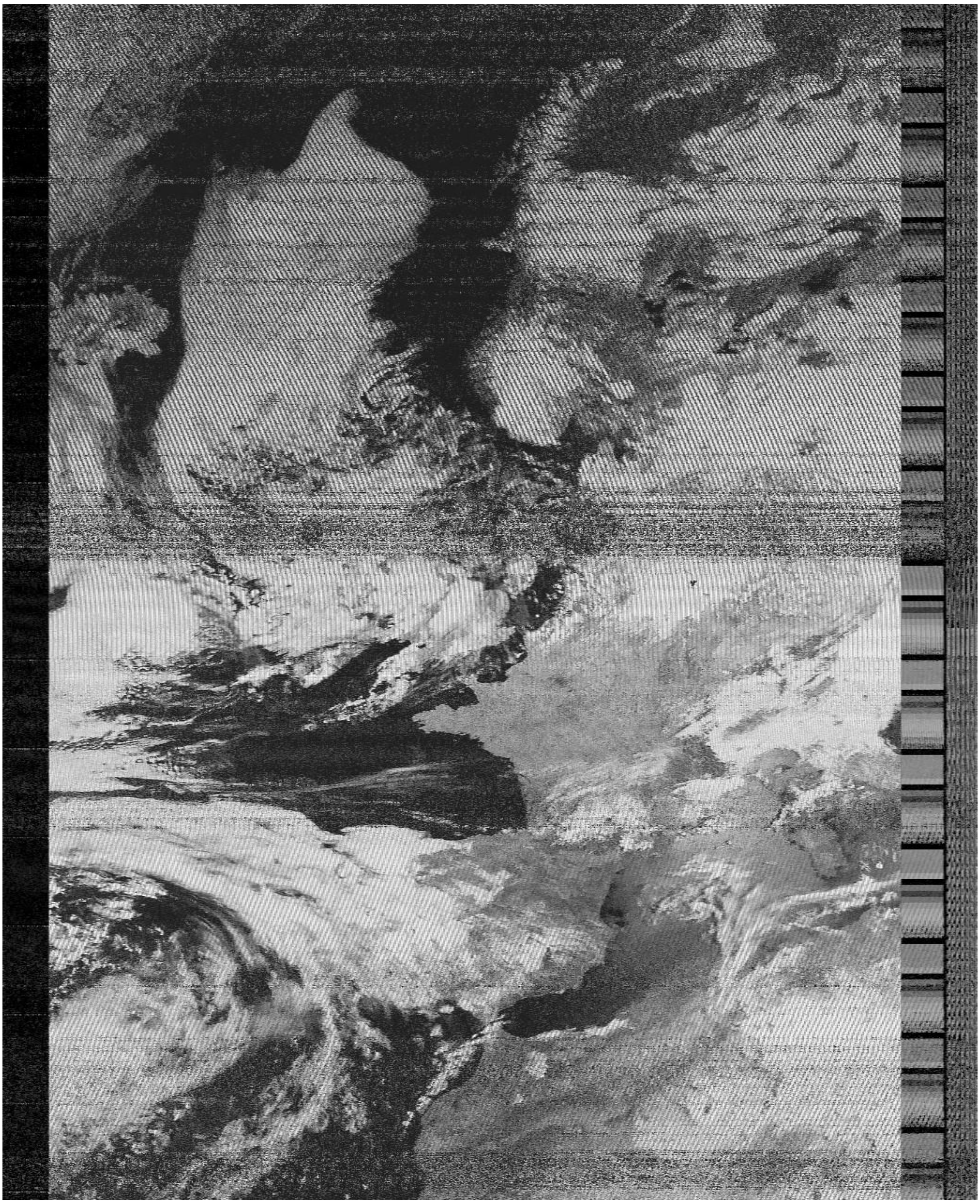

Fig 9.1: Decoded Image from the v-dipole. (This is a gray-scale image of a place in Nuremberg Skyscraper Germany, Bavaria).

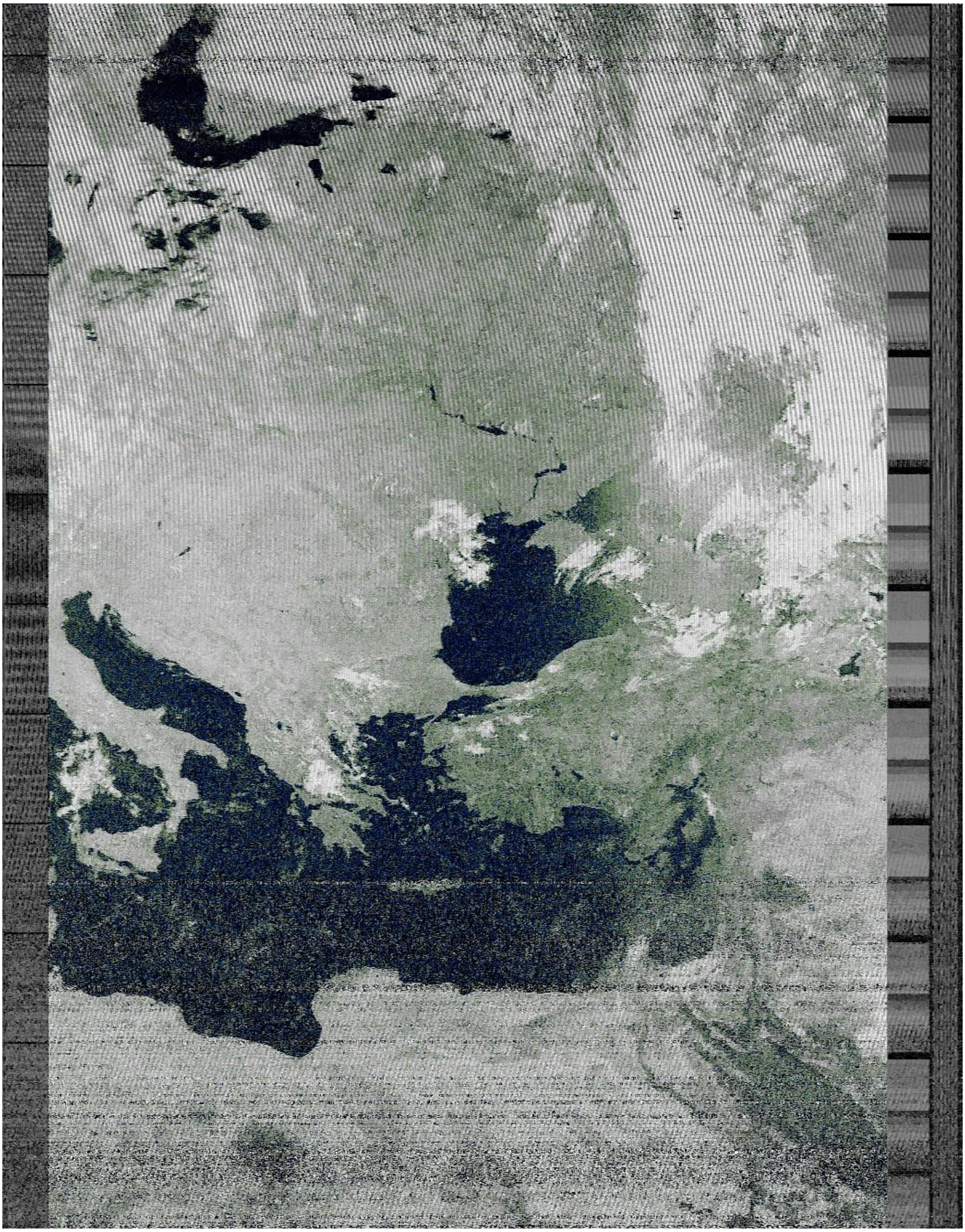

Fig 9.2: Decoded Image from the v-dipole. (This is a false-colour image of a place in Nuremberg Skyscraper Germany, Bavaria).

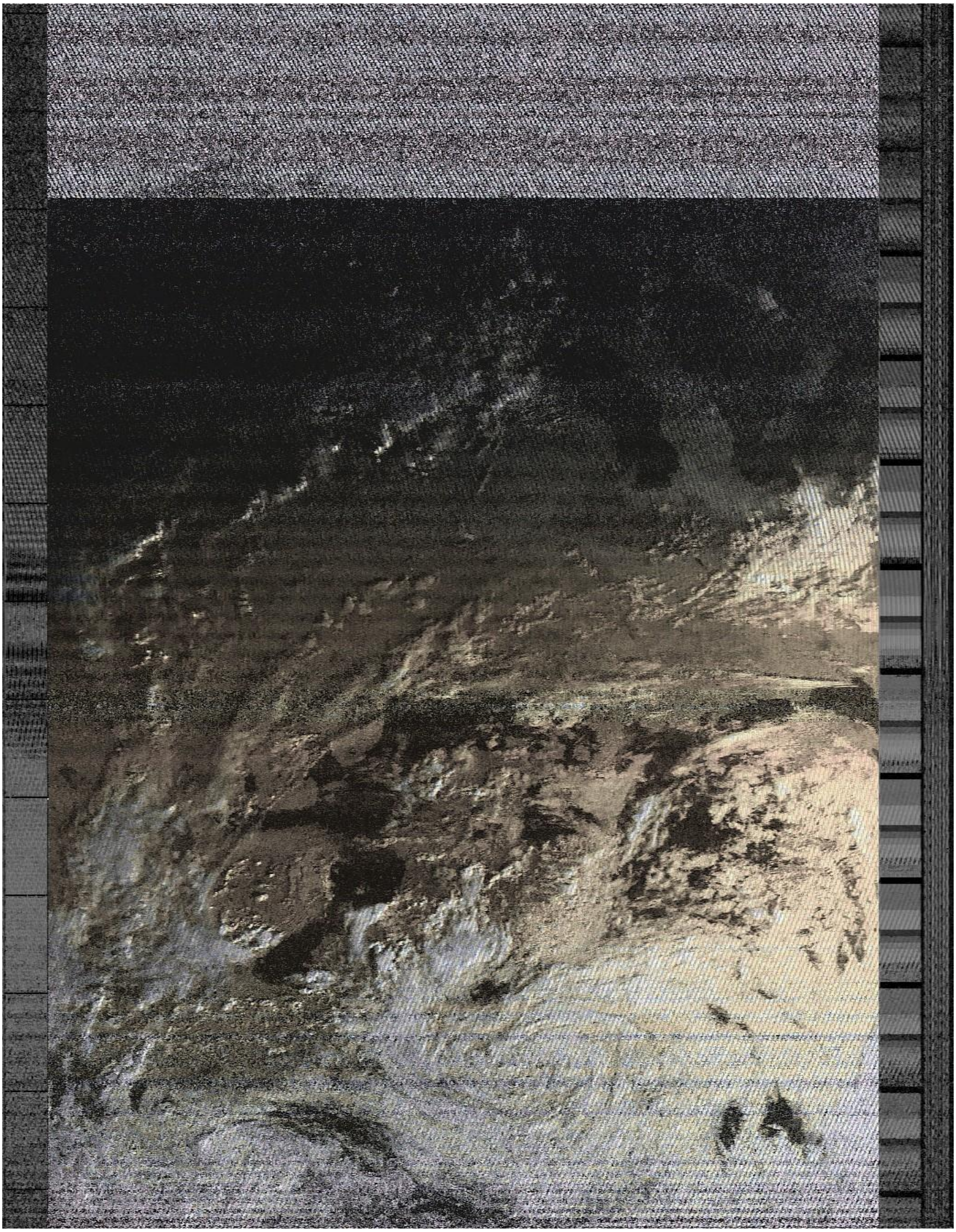

Fig 9.3: Decoded Image from the v-dipole. (This is a gray-scale image at night, of a place in Nuremberg Skyscraper Germany, Bavaria).

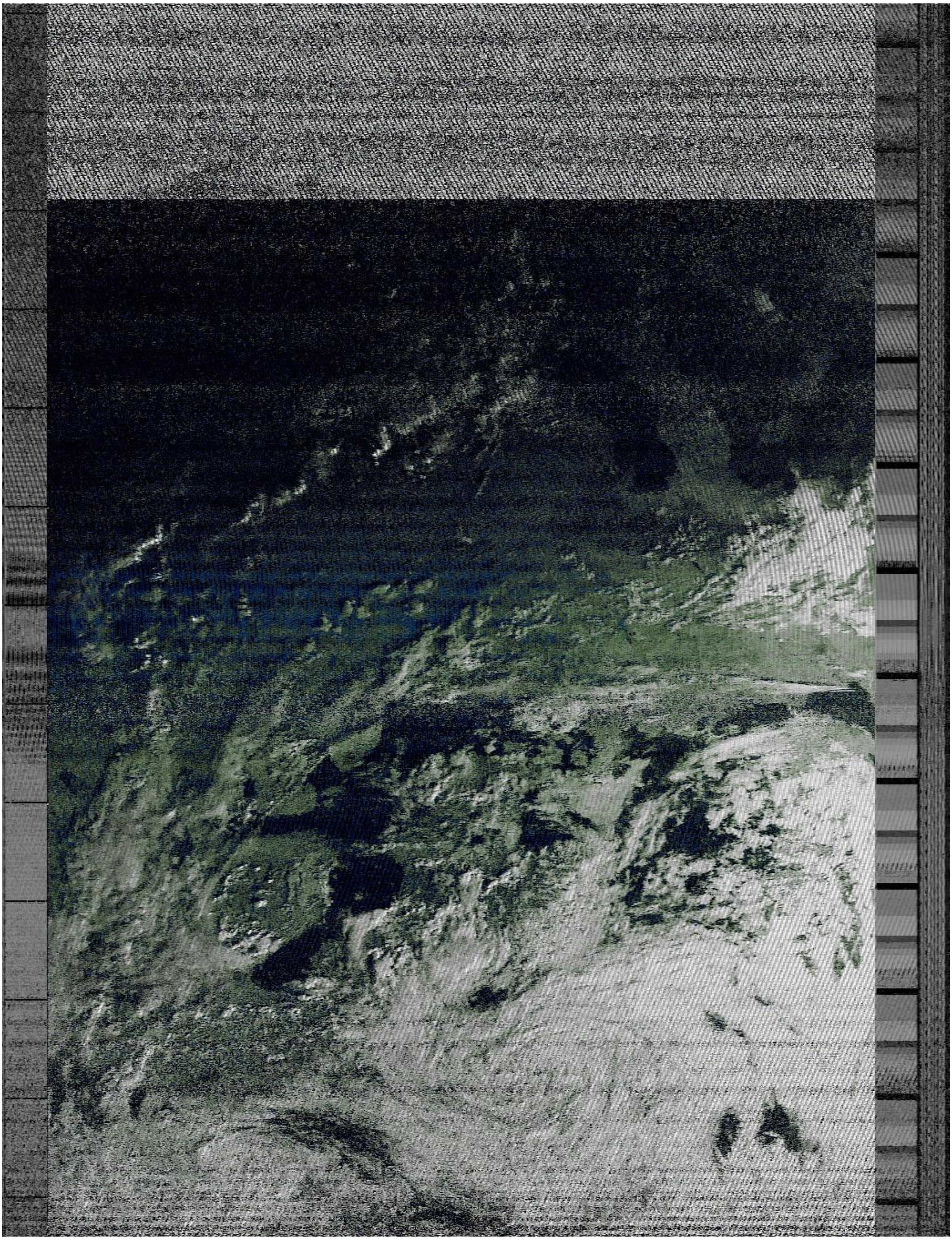

Fig 9.4: Decoded Image from the v-dipole. (This is a true-colour image at night, of a place in Nuremberg Skyscraper Germany, Bavaria).

10. APPENDIX A

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