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Atmospheric Data Collecting Cubesat using Raspberry PI

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Abstract: ***As advances in technology make payloads and instruments for space missions smaller, lighter, and more power efficient, a distinct segment market is emerging for low-cost missions on very small spacecrafts such as - micro, nano, and picosatellites. Due to the fact that even after many technological advances the usage of miniature satellites the remote sensing of atmospheric is still not a widely explored aspect, to overcome this we idealized a system to build a CUBESAT which can be built with minimal efforts. We proposed this system with an objective to build a CUBESAT to detect different weather aspects of our earth at the troposphere layer which is the lowest layer of earth. We implemented our project using the Raspberry Pi due to its versatility in multi-processing and connectivity. Here the Raspberry-Pi is going to be configured with transceiver modules in the CUBESAT's sender-end to gather atmospheric data associated with temperature, gasses present, humidity and pressure using CUBESAT sensors and after the reception of data at ground station by Arduino configured as receiver, data is going to be stored in an accessible website for viewing and further computations.***

Keywords: CUBESAT, Atmospheric Data, Raspberry-Pi, Arduino, Transceiver, Temperature Sensor, Pressure Sensor.

I. INTRODUCTION

Small-sat covers a totally broad assortment of satellites that might be just about as little as Femto satellite television for pc with a mass as miniscule as 10 to one hundred grams. "Small-sat" is regularly referenced a satellite television for pc that has a mass of as much as 500 kg or more noteworthy. In among there are "CubeSats" that every now and again assortment between 1 unit to six gadgets in size. Such 'CubeSats' will have a mass as little as around 1 kg or have a for the most part surpassing ten kilos for a 6-unit 'CubeSat'. Little satellite television for pc comprehensively speaking CubeSats are normally understudy project, or exceptionally focused a specific clinical mission. It tends to be just one out of 1000 little satellites intended for an enormous low Earth oral living being. These notable as little satellites is most likely mass delivered with added substances regurgitated through three dimensional printers, or meticulously created through understudies working to make their own in circle satellite television for pc. The differentiation among the littlest small sat and a boundless small sat might be more prominent than 4 significant degrees. CubeSat-sized constructions to work are essentially in a programmed style to help remote, broadcast communications, or various capacities. This also permits decline value floor sections. Little satellites might be classified withinside the accompanying:

1) Minisatellite (100 - 500 kilos)
2) Microsatellite (10 - 100 kilos)
3) Nano satellite (1- 10 kilos)
4) Picosatellite (0.1 - 1 kilos)
5) Femtosatellite (0.01 - 0.1 kilos)

CubeSat is a nanosatellite broadly speaking used for the studies projects. Kits are to be had as much as 1.33 Kg. CubeSat started out as a col attempt in 1999 among Jordie Puigui-Suarigo, who is a professor at Calibian Polytheistic University (Cal Polycon), and Bob Twiggns, a professor at Stangley Space Systems Public Development Library Transport (SSPDT). CubeSats have enabled many most important or smaller universities, excessive colleges to go into the gap application. In addition to instructional institutions, Government groups and business businesses round the sector have advanced CubeSats. They diagnosed that the small, standardized platform of the CubeSat can assist lessen the fees of technical tendencies and clinical investigations. This decreased barrier to access has substantially extended get admission to space, main to an exponential boom withinside the reputation of CubeSats because their inception. Indian Space Research Organization (ISRO) has promoted a couple of CubeSat application from numerous institutes. Specific technological know-how research regions include: organic technological know-how, observe of near-Earth objects, weather change, snow/ice coverage, orbital debris, planetary technological know-how, space-primarily based totally astronomy, and helio-physics. Communications, propulsion, navigation and control, and radiation checking out lead the subjects on this area. Other extraordinary technology are sun sails, additive manufacturing, femtosatellites, and clever telecall smartphone satellites.

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II. LITERATURE SURVEY

A. IoT based Temperature and Humidity Controlling using Arduino and Raspberry Pi, (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 10, No. 9, 2019.

This paper offers with the Arduino regulatory framework applied for surveying the temperature and mugginess of the contraptions, crushing component, and peak appraisal. The association incorporates the tallness surveying contraption and a comparing or controlling instrument. In these paintings, they proposed an Arduino UNO with Raspberry Pi statistics getting ready unit.

B. Loewenthalgy, Jared A., "A 6U CubeSat program for Plant moisture Experiments". Rochester Institute of Technology (RIT), December 13, 2019

This paper deals with the arrangement, gathering, and ground station of a 6U CubeSat stage got ready for plant improvement tests. The development that really incorporated four vague, yet self-governing plant improvement chambers. Each of these obliges around two cubic deadheads of soil, and the fundamental air volume and moistness rule to grow a rapidly creating plant starting with one seed then onto the next 4 of month.

C. Raspberry PI and Arduino UNO Working Together as a Basic Meteorological Station, October 2017, International Journal of Computer Science and Information Technology 9(5):97-104

The current paper portrays a novel Raspberry Pi and Arduino UNO designing used as a meteorological station. One of the potential gains of the proposed configuration is the tremendous measure of sensors made for its utilization; fundamentally one can find them for any application, and environment identifying is definitely not an exceptional case. The standard followed is to plan Raspberry as a finder for measures got from Arduino, sending occurs through link; in the meantime, Raspberry imparts them through a site page.

D. Next-Generation Warehouse Ecosystem for Climate Data Warehouse and Information Discovery: A Review of New Data Collection Technology, Department of Public Policies, University of North Carolina-Charlie Hills, Chapel Hill, NYC, United States

This paper examines about natural change has been grouped "the portraying obstacle of our generation" however then the overall neighborhood good information to appreciate whether exercises to address it are succeeding or fail to direct it. The ascent of advances, for instance, earth discernment and Internet-of-Things pledges to give new advances in data grouping for checking ecological change lightening, particularly were traditional techniques for data examination and assessment.

III. HARDWARE REQUIREMENTS

A. Raspberry Pi 3 Model B+

There are different models of Raspberry Pi however project deals with model B. It has eight broadly useful info/yields, two USB ports, a top quality media interface (HDMI) yield, furthermore, other non-significant highlights for this undertaking. Moreover, Raspberry Pi needs a working framework which is put away on a protected computerized (SD) card. Working framework determination was difficult,as a result of the great amount of them; the more significant one are Raspbian, Pidora, and RISC OS. Raspbian was chosen for current task for the wide variety of instructional exercises and data accessible on the web. Raspbian is a free-permit Linux working framework dependent on Debian and enhanced for its utilization with Raspberry Pi equipment. Raspberry plays as the focal remembering unit and it is adequate as a result of its high level and refined highlights; be that as it may, for detecting and filling in as gathering satellite unit it is larger than usual,so a more modest gadget is required. There are numerous alternatives, however for the current task, the decision is Arduino UNO .Here we have used Raspberry Pi 3 Model B+ that is available in the markets all over the world.

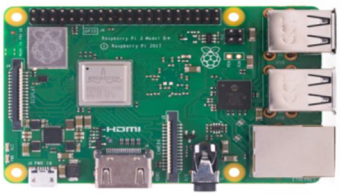


Fig-1: Raspberry Pi 3 Model B+

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B. Arduino

Arduino is an open-source contraptions stage subject to easy to-use hardware and programming. Arduino emblems can get inputs - light on a sensor, a finger on a catch, or a Twitter message - and change it's anything but a yield - starting a motor, turning on a lights, disseminating something on the web. You can direct your board by sending a lot of bearings to the microcontroller on the board. To do so you use the Arduino programming language (considering connectors), and the Arduino Software, considering Proceedings.

All through the drawn out Arduino has been the frontal cortex of hundreds of exercises, from customary things to complex sensible instruments. A general neighborhood understudies, trained professionals, skilled workers, programmers, and specialists - has amassed around this open-source stage, their responsibilities have added up to a stunning proportion of open data that can be of exceptional help to students and experts the equivalent.



Fig-2: Arduino UNO

C. BMP180 Barometer Sensor

The BMP180 was proposed to definitely check barometrical squeezing factor. Natural squeezing factor valued with twills environment with stature; you can measure all of these using this device. The significance of squeezing factor is a force "crushing" on a space. A common unit of squeezing factor is pounds of square inch. 1 pound, pushing on one square inch, approaches one psi. The fundamental unit is newtons per square meter, which are called Pascal(PA).

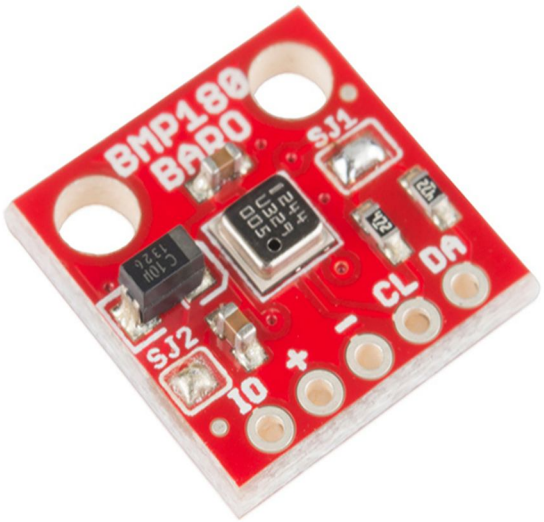


Fig-3: BMP180

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D. DHT11/22 Sensor

The DHT11/22 sensor can anyways be punched as a device or as a model. Regardless, the introduction of the sensor is similar. The sensor will come in 3-pin group out of which only two pins will be used while the module will go with three pins as shown already. The single differentiation between the device and model is that the model will have a filters and capacity with pulling resistance in the box, and for the device, you need to wide them distantly at whatever point required. The DHT11 is a fundamental, ultra imporial cost progressed temperature and moisture sensor. It uses a counter tenacity sensor and a thermo-resistor to evolute the enveloping atmosphere, and lets in a high level signal on the data port (no straightforward information pins required). Its truly simple to build, yet requires hurry wanting to grown data. The solitary authentic weakness of this sensor is you can simply got new data from it twice predictably, so while using our liberty, sensor linigs can be up to 15 seconds .

Stood out from the DHT22, this sensor is less definite, less exact and works in a more humble extent of temperature/moistness, yet its more unassuming and more reasonable.Goes with a 4.75K or 9.9K resistor, which you should use as a pullup from the data pin to VCC.

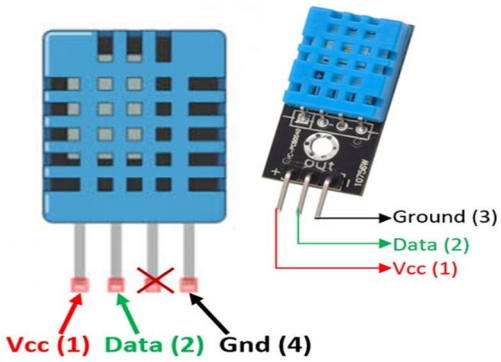


Fig-4: DHT11/22

E. DS18B20 Sensor

The electronic temperature sensor like DS18B220 follows multi wire show and it will in general be used to evaluate temperature in the extent to - 68oF to +267oF to - 58oC to +128oC to +-6% precision. These extent forgot digits from the 1-warehouse can go to 8-piece to 16-clock. Since, this sensor follows the single wire show, and the controlling of this ought to be conceivable through a lone port of Microcontroller. They are general show, where every sensor can be stunt with a 64-cycle successive code which assists with controlling different sensors using a multi port of the microprocessor.

The DS18B220 is that sort of temperature sensor and it applies 8-piece to 16-piece notings of temp. These characteristics show the importance of temper of a particle contraption. The correspondence of this sector ought to be conceivable through a double-walled transport show which uses two data link to talk of an internal computer chip. Addition to that, this also gets the energy supply defined from the data link so the necessity for an external power supply can be cleared out. The employments of the DS18B220 temperature sensor consolidate present day signals, purchaser things, structures which are sensitive theoritically, periodically controls, and thermosphere.

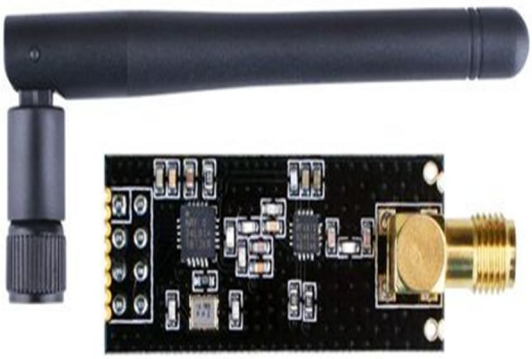


Fig-5: DS18B220 Sensor

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F. NRF24L01+PA+LNA(Transceiver)

The nRF24L01+ handset module is planned to work in 2.45GHz generally ISM repeat band and uses GFSK guideline for data transmission. The data move rate can be one of 265Mbps, 2Kbps and 6Kbps.

The functioning voltage of the module is from 1.8 to 3.9V, anyway luckily the reasoning pins are 6-V indulgent, so we can without a doubt interface it's anything but an Arduino or any 6V reasoning microcontroller without using any reasoning level converter.



Fig-6: NRF24L01+PA+LNA

IV. WORK FLOW

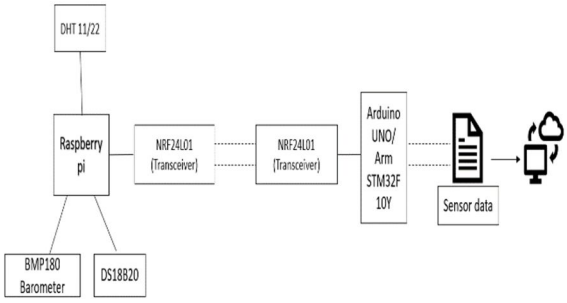


Fig-7: Work flow diagram

V. METHODOLOGY

1) Step 1: Setting up and installing Raspbian OS on the Raspberry pi

The Raspberry Pi OS highlights of mainly 4 diverse establishment alternatives:

a) Raspberry Pi OS Lite: The littlest of the pack. It is the most stripped down rendition of the Raspberry Pi OS. It doesn't accompany a Desktop Environment.

b) Raspberry Pi OS: The standard establishment which just has the Pixel Desktop Environment

c) Raspberry Pi OS Full: This is an full establishment incorporates the Desktop Environment close by an assortment of other usefulness programming.

d) Raspberry Pi OS Buster: A Desktop window form of the Raspberry Pi OS.

2) Step 2: Installing process and setting up of Arduino IDE on our PC:

Instructions to keep up the Arduino software on our PC and set up the board to get the program with the help of of USB connection.

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3) Step 3: Connecting NRF24L01 Module to Arduino

Since we have an all-out appreciation of how nRF24L01+ handset module capacities, we can begin interfacing it for our arduino UNO.

In particular, partner VCC nail to the module to 3V on the arduino and GND pin to ground. The pins CSN and CE can be related with any modernized nail to the arduino. For our circumstance, it's related with cutting edge pin 8 and pin 9 separately. By and by we are remaining with the pins that are used for SPI correspondence.

VI. IMPLEMENTATION

A. At Sender

After the connection of NRF sender module circuit accordingly to the Raspberry Pi 3 Model B+, the image will be as shown below:

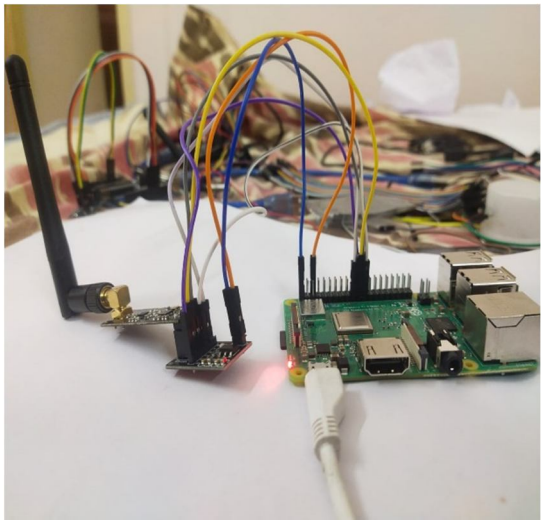


Fig-7: Connection diagram at Transmitter end

We need to write python code for NRF Transmitter Side (Raspberry Pi).

B. At Receiver

After connecting the NRF Receiver module circuit accordingly to the Arduino UNO, the image will be as shown below:

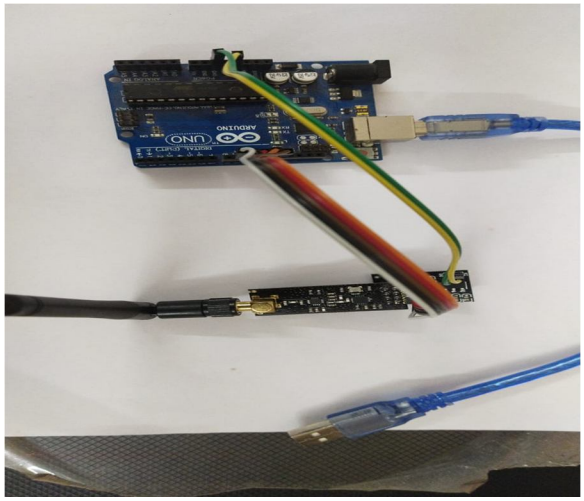


Fig-8: Connection diagram at Receiver end

We need to write C Language code for NRF Receiver Side (ARDUINO UNO).

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VII. RESULT

After integrating all the components and putting in a CUBE structured box, the image will be shown as below:



Fig-9: Overall View of CUBESAT

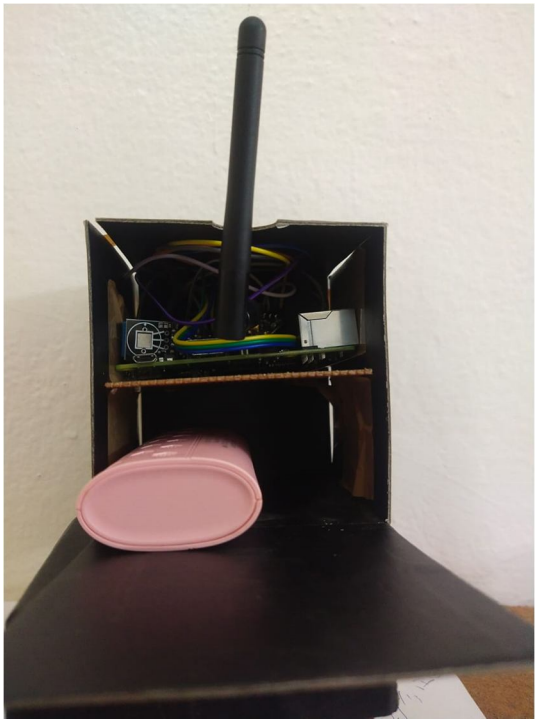


Fig-10: Inside View of CUBESAT

After integrating all the components and powering up, the transmitter's side sends the sensor data and then the receiver side Arduino receives them also computes them and finally the output values are displayed. By clicking on the serial monitor icon, a window will be opened where the output gets displayed as shown below:

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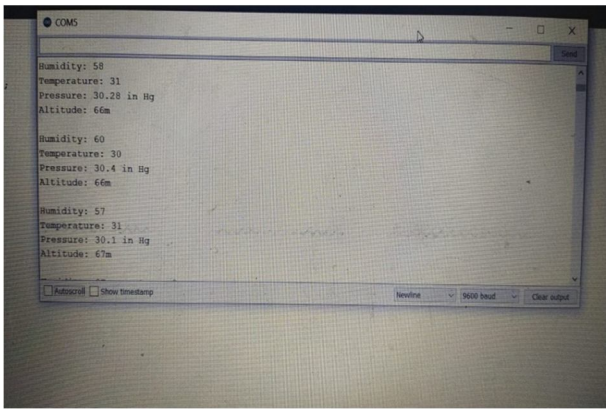


Fig-11: Output Window

VIII. ANALYSIS

As we configurated the python code in boot loader of raspberry pi, the code will be executed automatically when the power is ON. Once the programme starts getting execution, all the sensors i.e., humidity, pressure, temperature and altitude and will be sent to the ground station using NRF transceiver module. As displayed on the screen, the output sensor values received at the ground station are shown in the serial monitor. The Ground station is a significant piece of the venture as its investigations the got information. This framework is acknowledged by the understudies understanding the detail of correspondence frameworks and information move. This has drawn out a proficient ground framework which spoke with the model module productively and acknowledged in for minimal price. Quick innovation development has contributed towards various headways in satellite innovation which helps in giving an issue free encounter and the usefulness. The framework execution will be additionally improved to deal with higher pace of Data transmission and ongoing presentation of most basic boundaries.

IX. FUTURE SCOPE

Image processing using Raspberry pi is simply opening its arms, Same framework can be pertinent to the assortment of utilizations like Data checking, sending and controlling of information at far off area. In this undertaking I have utilized sensors with advanced info yet with reasonable A-D convertor we can undoubtedly utilize sensors with simple information. As applications are in a real sense boundless, we can send SMS or E-mail through Raspberry Pi. Subsequently, such a framework can be promptly carried out utilizing a minimal expense PC like Raspberry Pi which can work like a total PC. Utilizing dampness sensor Automatic water system control should be possible to get data about field and likewise water siphon will turn on. Information can be observed utilizing infrared sensors and pressing factor sensors in Surveillance framework.

Raspberry Pi productively accomplishes crafted by climate station in light of it's a minimal yet extremely amazing gadget. This unit degree by adding a water system framework. This model can be changing with the auto revive framework. Contrasting and assortment and sending data or information of customary base station (door), this framework has minimal expense, low force utilization, and simple to One significant benefit of the framework lies in the keep up. Combination of the door hub of remote sensor organization, sensor network into one single minimal, low-power, Mastercard estimated PC Raspberry Pi, which can be effectively arranged to run without screen, console, and mouse. Such a framework is extremely valuable in numerous natural observing and information assortment. In future, we can get information from a more prominent number of far-off stations with exact and quick estimation and we can even add more sensors to the present proposed one. web interfaces can be created to execute the new applications like information envisioning and information the executives.

X. CONCLUSION

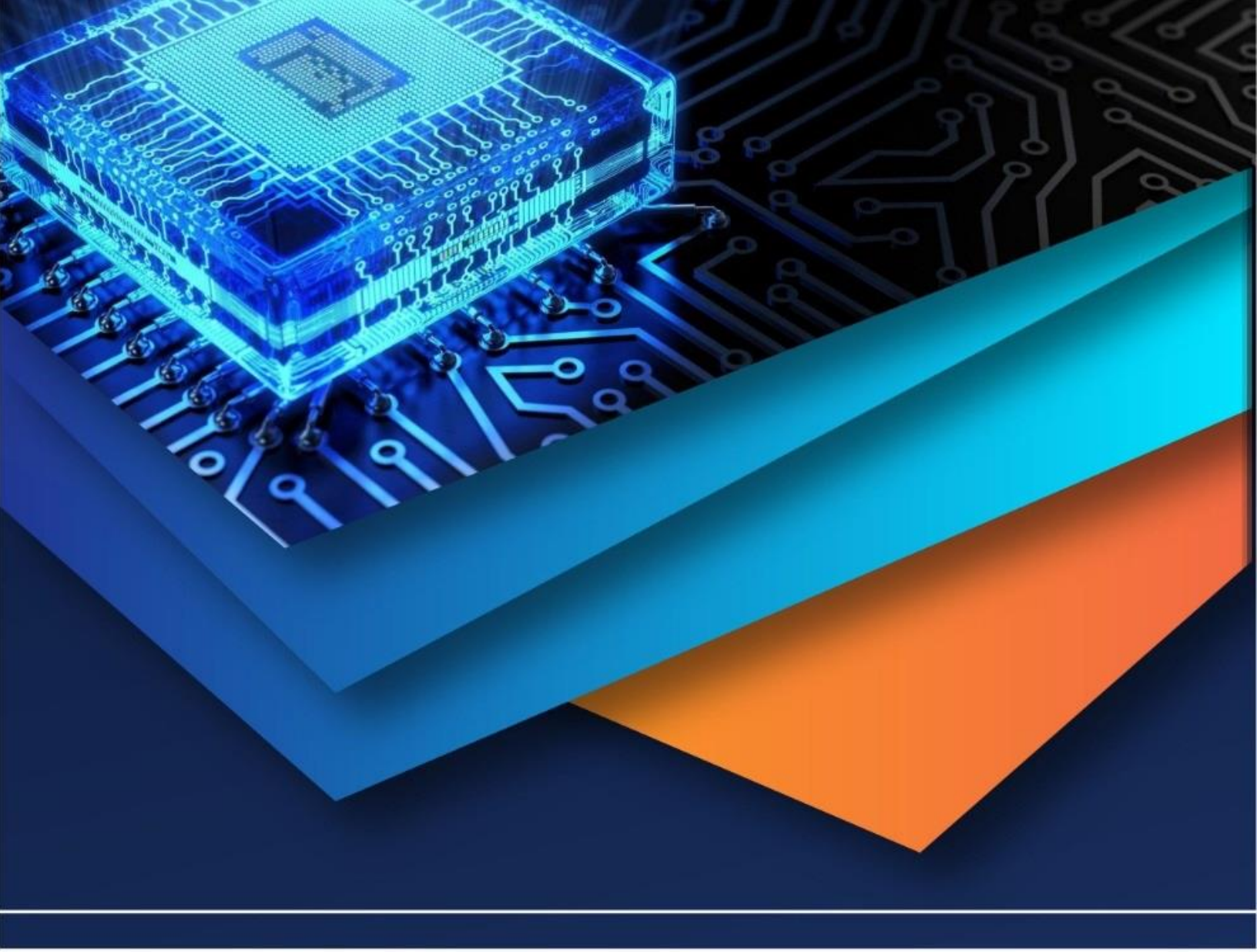
The main aim of the project is to collect the atmospheric data like pressure, humidity, temperature, etc. over a particular area. Here we are using temperature, humidity and pressure sensors to sense the atmospheric properties and send them using nrf modules which ranges up to 1km.We receive them at ground station where we use an Arduino which is connected to an nrf module to receive the data from raspberry pi, from here we are displaying the atmospheric data in a serial monitor.

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