International Journal of Innovative Research in Technology, Science & Engineering (IJIRTSE)
www.ioirp.com ISSN: 2395-5619, Volume – 4, Issue – 1. March 2018

ATMOSPHERIC WEATHER MONITORING USING PARACHUTE SATELLITE-CANSAT

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ABSTRACT

In this paper, we describe the process to construct a can-satellite to measure atmospheric weather conditions. The primary work is the CanSat must be able to analyze the temperature, air pressure and humidity in the space. For these purposes several sensors used such as temperature sensor, humidity sensor and pressure sensor. The Zigbee which we are using for the communication purpose is configured as transmitter and receiver module is then coded and dumped along with sensors. These components are interfaced to Arduino Nano making up a size of a Can. At ground station, monitoring is done for the above weather parameters in a device maybe done using laptop or PC. The data is then sent to the cloud platform to analyze the variations in virtualized manner. The CanSat is then launched to a height of approximate 400m by using a balloon. After reaching the certain height the CanSat is then ejected from the balloon. The balloon is designed in order to withstand in space. The CanSat built can be launched and used to monitor local weather for an area, in an economical way, especially for the farmers who cultivate crops according to the seasons and climate. We have elaborated our work on this paper.

Keywords: CanSat, Weather monitoring, Sensors, Arduino, balloon, Zigbee.

I INTRODUCTION

The need for weather monitoring and atmospheric conditions are growing day by day nowadays. Measuring these parameters at high altitude constantly is difficult. By using low altitude satellites these parameters are easily calculated and the real time data is readily available to the users. A CanSat is a simulation of a real satellite, integrated within the volume and shape of a soft drink can. The aim is to fit all the major subsystems found in a satellite, such as power, sensors and a communication system, into this minimal volume. Arduino is an open-source electronics platform based on easy-to-use hardware and software. Zigbee series module act as both transmitter and receiver for communication from ground station to the space. The monitored data's are stored into cloud by using nodemcu as a gateway. The CanSat is then launched to an altitude of a few hundred meters by a rocket or dropped from a platform, a drone or captive balloon, and its mission begins to carry out a scientific experiment and achieve a safe landing. The CanSat must be cautiously developed in order to sustain some time in space at few hundred meters. Present CanSat power system involves Li-ion battery. The entire system is designed ensuring the weight is less than 750 grams. The modules used in the CanSat systems must be highly sensitive in order to monitor the minimum variation in temperature or pressure in space.

II PROBLEM DEFINITION

The CanSat is mainly used for analysing weather parameters for a shorter time withstanding in space. Since weather is a variable parameter, the farmers must know the weather and climate at real time and at a particular location where they are cultivating their crops. Since weather reports normally describe the climate of a whole town/city. They must know the surrounding climate around his farm and so they will be easily able to cultivate the crops. This will be very useful for farmers who can able to predict the weather for future cultivation process.Zigbee-based agriculture monitoring system serves as a reliable and efficient system for efficiently monitor the environmental parameters like temperature, pressure etc.

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III PROPOSED WORK

All the components must be embedded to a can sized object. Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read input and turn it into an output. The boards are equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits. The temperature, humidity, pressure in the atmosphere is monitored by the specific sensors such as (DHT11&BMP180). Zigbee series 2 modules act as both transmitter and receiver for communication from ground station to the space. The monitored data's are stored into cloud by using nodemcu as a gateway. Satellites normally return to Earth using a Parachute or balloon. Present CanSat power system involves Li-ion battery. It uses a power supply to the CanSat module. The entire system is designed ensuring the weight is less than 750 grams.

The Block diagram for the proposed system is shown below:

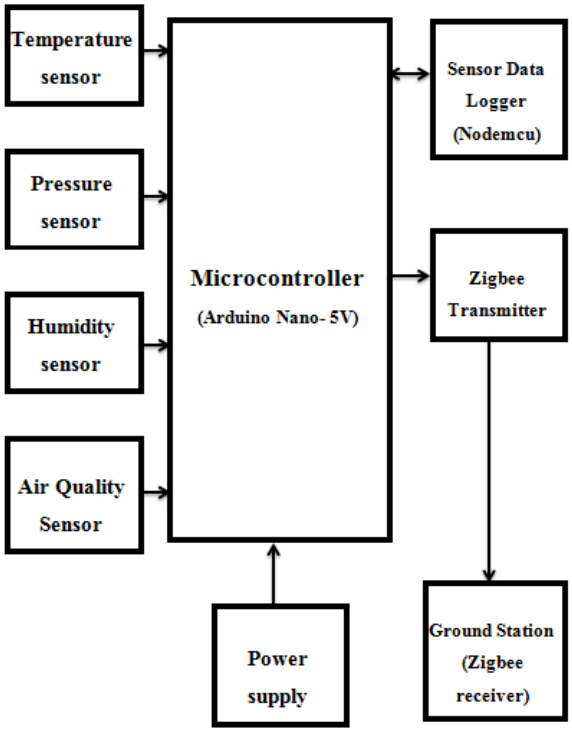

Figure 1: Block Diagram of CanSat

IV HARDWARE COMPONENTS

A) DHT11 SENSOR

DHT11 is a Humidity and Temperature Sensor, which generates calibrated digital output. DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc. and get instantaneous results. DHT11 is a low cost humidity and temperature sensor which provides high reliability and long term stability. In this project, we will build a small circuit to interface Arduino with DHT11 Temperature and Humidity Sensor. One of the main applications of connecting DTH11 sensor with Arduino is weather monitoring. It uses a capacitive humidity sensor and thermistor to measure the surrounding air, and gives a digital signal on the data pin. It's fairly simple to use, but requires careful timing to grab data.

B) BMP180 SENSOR

The BMP180 is the new digital barometric pressure sensor of Bosch Sensor etc., with a very high performance, which enables applications in advanced mobile devices, such as smartphones, tablet PCs and sports devices. It follows the BMP085 and brings many improvements, like the smaller size and the expansion of digital interfaces. The ultra-low power consumption down to 3 µA makes the BMP180 the leader in power saving for your mobile devices. BMP180 is also distinguished by its very stable behavior performance with regard to the independency of the supply voltage.

V COMMUNICATION MODULE

A) ZIGBEE MODULE

Figure 2: Zigbee S2 Module

To create sensor networking and weather station monitoring system without human mediation, utilizing Wireless Zigbee Technology. Zigbee is the

most recent remote climate checking method. Arduino based system for weather monitoring is used in this project, as Arduino is compact in size, less weight and easy to use. Communication part of the arrangement consists of a Zigbee network, which is employed with Zigbee S2 RF module. Communication is established with one module attached to the CanSat and another module connected to the ground station terminal. Transmitter on the CanSat receives all the sampled data via serial interface from microcontroller, and transmits it to the receiver on ground station using radio waves. The frequency band for operation is 2.4 GHz.

B) NodeMCU ESP8266 MODULE

Figure 3: Nodemcu module

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term NodeMCU by default refers to the firmware rather than the dev kits. The firmware uses the Lua scripting language. The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.

C) Arduino Nano MODULE

Arduino Nano is a surface mount bread board embedded version with integrated USB. It is a smallest, complete, and bread board friendly. Physically, it is missing power jack.

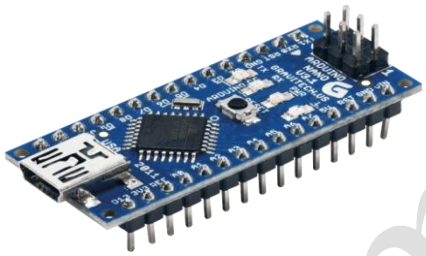

Figure 4: Arduino Nano module

The Nano is automatically sense and switch to the higher potential source of power, there is no need for the power select jumper. Nano's got the breadboard-ability of the Board UNO and the Mini USB with smaller footprint than either, so users have more breadboard space. It's got a pin layout that works well with the Mini or the Basic Stamp (TX, RX, ATN, GND on one top, power and ground on the other). This new version 3.0 comes with ATMEGA328 which offer more programming and data memory space. It is two layers. That make it easier to hack and affordable.

VI SOFTWARE DESCRIPTION

A) ARDUINO IDE

The open-source Arduino software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X and Linux. The environment is written in java and based on processing and other open source-software. It provides comprehensive facilities to computer programmers for software development. Programs written using Arduino software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension. These programs can be uploaded into the Arduino board using this software having the facilities of compiling and uploading. This software can be used with any Arduino board. In this system, Arduino IDE helps to upload the program developed using embedded C language into the board for the processing of the system.

B) XCTU SOFTWARE

X-CTU is free software provided by Digi which we use to configure and manage XBees, and test XBee networks. The tool provides a GUI and terminal interface to configure the modules as well as a built in tool to test the Xbee range and reliability of packet

transmissions. Zigbee Voltage Supply is 2.8V - 3.4V. All units will need matching PAN ID, Channel and Sleep Mode settings to function together as one network. All nodes must have the Coordinators address to know it is the end destination for data transmission. Coordinator must be in API mode to see data from node I/O pins Configuration Transparent Mode with API. Frames generator is used which easily generate any kind of API frame to save its value Range test is done to perform a range test between 2 radio modules of the same network.

VII CANSAT BODY DESIGN

The CanSat body is made in the shape of a cylinder with discs placed inside the cylinder with the help of channels. Components can be glued onto the disc using epoxy glue for stability and protection of the system. The body is fabricated using acrylate plastic which is known for its strength, lightweight and durability. The entire system is designed ensuring the weight is less than 750 grams.

A) BALLOON DESIGN

Balloons are fun, but the helium ones are always more entertaining. So today, we're going to learn how to make hydrogen gas by combining drain cleaner with aluminum foil. With hydrogen, you get the same lighter-than-air properties of helium, plus it will explode.

Materials

- Drain cleaner
- Aluminum foil
- Balloon
- Glass bottle

Reaction formula

$$2Al + 2NaOH + 6H_2O \rightarrow 2Na[Al(OH)_4] + 3H_2\uparrow$$

B) PARACHUTE DESIGN

A parachute is an umbrella-shaped device of light fabric used especially for making a safe jump from CanSat. During its descent, due to its weight the gravitational force accelerates the CanSat downwards.. Satellites normally do not return to Earth in a parachute. At the end of their useful life, a satellite will be put in a different orbit. For satellites orbiting at a low altitude this could mean they will burn up in the atmosphere. Satellites further away will end up in a much

more distant parking orbit and will circle our planet forever.

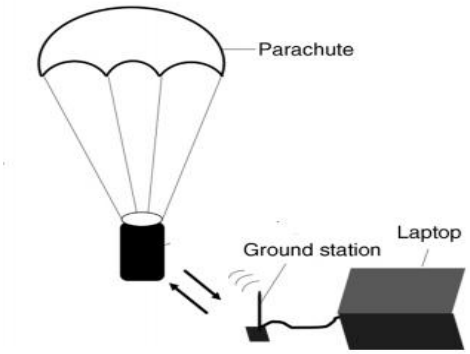

Figure 5: Parachute Design

Sometimes however the spacecraft has to return to earth with samples or astronauts. One of the solutions is then to descend in a parachute. When the CanSat is deployed it must have a device to slow it down, otherwise it will crash into the surface. The parachute also helps ensure that the CanSat stays in an upright position. This is particularly important because it helps to maintain proper antenna orientation, which maximizes the chances of receiving telemetry.

RESULTS

As far we have configured Zigbee to send and receive data's and the necessary sensor modules such as temperature, humidity, and pressure are interfaced with the Arduino and nodemcu modules**.** The Arduino Nano is configured as transmitter side in which the above sensor modules are interfaced. The nodemcu acts as a receiver part in which the sensor data's are then continuously sent to thingspeak cloud server. The temperature and humidity data's are depicted in graph format in the cloud. For this purpose we are using field chart for depicting temperature and humidity values.

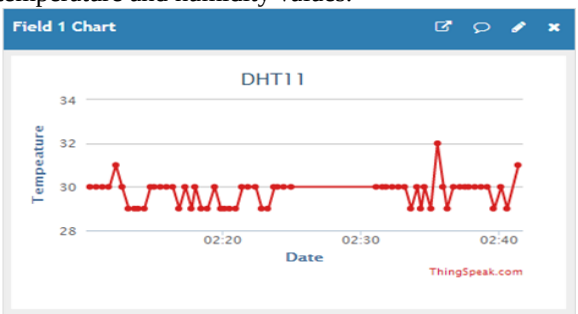

Figure 6: Graphical representation of temperature values into cloud server

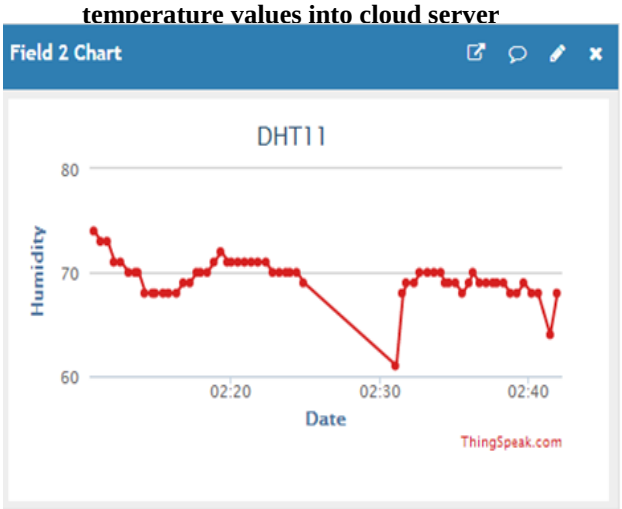

Figure 7: Graphical representation of humidity values into cloud server

CONCLUSION & FUTURE SCOPE

The CanSat offers wide range of applications in the field of weather monitoring, navigation, Space research organisation etc. The development CanSat is further improving nowadays to analyse more parameters at a greater height. Sensors and power subsystems are made in smaller sizes to reduce the weight of CanSat at further extent. The parameters such as temperature, pressure, humidity were monitored. The monitored data's are stored into cloud by using nodemcu as a gateway.Future scope involves powering the whole CanSat using batteries. It also involves improved aerodynamic structure in order to increase the stability and flight of CanSat. The sensed data's are stored into the open source IOT by using nodemcu as a gateway module. The CanSat have a recovery system, such as a parachute or balloon which are capable of being reused after launch. By using balloon as recovery system are highly recommended to facilitate recovery of the CanSat after landing with low cost. The parachute connections are able to withstand up to 1000 N of force. For recovery purpose, a maximum flight time of 120 seconds is recommended. A descent rate between 8 and 11 m/s is recommended for recovery reasons. The CanSat project is able to withstand an acceleration of up to 20 g. The strength of the parachute must be tested to ensure that the system will operate nominally. Further Rocket and Quad copter testing will be done to test flight path of CanSat.

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