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**A Project Proposal**

**On**

**“Pico Sat”**

**[Course Code: COMP 303]**

**(For partial fulfillment of III Year/ I Semester in Computer Engineering)**

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**Submission Date:**

12th November, 2019

# Abstract

A Pico Sat is a simulation of a real satellite with mass less than thousand grams and integrated with subsystems such as on-board computer, microcontrollers, sensors and communication systems. Climate change presents the single biggest threat to sustainable development everywhere. So, we are creating a prototype of a Pico Sat as a research project. We plan to implement this project in our university to get and monitor the environmental data. The main objectives includes measurement of temperature, pressure, altitude, dust, humidity and pollution. The collected data by sensors will be transmitted on real time through wireless channels and will be processed and retrieved on ground station. This data will also be available on the webpage which will be available publicly. We will also analyze the data and compare with previously available data. Since, research on this kind of technology is in growing phase in Nepal, this project could be a great milestone and foundation for development on space research projects.

**Keywords:** *Pico Sat, Climate change, Ground station, Environmental data*

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# Abbreviations

|  |  |
| --- | --- |
| **Short form** | **Full form** |
| PCB | Printed Circuit Board |
| DHT | Digital Humidity Temperature |
| BMP | Barometric Pressure |
| JS | JavaScript |
| SQL | Structured Query Language |
| HTML | Hypertext Markup Language |
| CSS | Cascading Style Sheets |
| UI | User Interface |

# Introduction

## Background

A Pico Sat is a simulation of a real satellite with mass less than thousand grams and integrated with subsystems such as on-board computer, microcontrollers, sensors and communication systems.[7] The system consists of a ground station for receiving the real time data from the Pico Sat and the data is projected in GUI. This project offers a unique opportunity for us to have a first practical experience of real space project.

Climate change presents the single biggest threat to sustainable development everywhere. This has inspired many scientists studying about weather impacts in living as well as non-living beings. Previously, there were simple and inaccurate instruments, which were inadequate for easy reading and storing data. Nowadays, there are many advanced observatories and labs collecting the environmental parameters continuously for different applications. However, these come at the high cost of time, money and human resources. In this scenario, miniaturized satellites can play an important role not only in the academics, but also in scientific projects for observing, monitoring and analyzing the environmental data. Even though, the cost for constructing small satellites is very low compared with those of the standard sizes designed for science and communication missions, the data provided by these satellites are found to be highly reliable.[4] So, with the help of this Pico Sat we can study the real time data of atmosphere and represent the data visually for easy analysis.

This is our research-based project where we are trying to develop a prototype for measuring environmental parameters using relatively inexpensive components. We will be collecting environmental data from our university location and create a system for visually monitoring the data from ground station. The data will also be accessible via website. By collecting the data from different sensors and analyzing various data we can study about the current climatic conditions of our location. Pollution can also be monitored, and alerts can be generated. By comparing our data with the data from pre-existing sources we will be able to know about usefulness and status of our system.

## Objectives

We have initiated this project with following objectives:

1. To retrieve real time data of pressure, temperature, altitude and humidity.
2. To detect dust level in atmosphere to analyze about pollution.
3. To alert and help coping about climate change.
4. To measure the weather statics of specific area, lab or industry.

## Motivation and Significance

Recently, Nepal launched its first satellite NepaliSat-1 successfully.[6] With this humble beginning Nepal has entered the Space-Era and the success of this project means we are now technically capable of preparing such satellites in future. New paths have opened for space engineering in our country.[8] Also, last month Kathmandu University Robotics Club (KURC) conducted a two-day workshop on Can Sat, which is a simulation of a real satellite, integrated within the volume and shape of a soft drink can. [1]

The significance of our project are:

1. We can study about our atmosphere from local level using our own technology.
2. We can compare our data with authoritative data to know status of our system.
3. Real-time data can be obtained from difficult terrain and high altitude.
4. Use our data for research and analysis purposes.

# Related Works

The concept of this type of Pico Sat is relatively new in our country. However, there have been a lot of Pico Sat related experiments and competition in other countries. This kind of system has been mostly used for educational purposes, but inclusions in scientific projects demonstrates that it can be used for both scientific and technological applications. Some of the related works are:

## 2.1. European Space Agency (ESA)

The European Space Agency (ESA) [3] is Europe’s gateway to space. Its mission is to shape the development of Europe’s space capability and ensure that investment in space continues to deliver benefits to the citizens of Europe and the world. ESA organizes different Pico Sat related competitions in Europe to increase support for space activities in Europe.

## 2.2. Defense Advanced Research Projects Agency (DARPA)

DARPA [2] initiated a microsatellite program featuring extremely small microelectromechanical systems (MEMS) radio frequency (RF) switches. The first picosat mission, launched on January 26, 2000, demonstrated MEMS RF switches operating on a pair of tethered satellites, each one weighing just over one pound. The program demonstrated how constellations of small satellites could work together in the future with dramatically reduced size and power requirements.

## 2.3. Dyacon

Dyacon, Inc. [5] was established in October 2007 in beautiful northern Utah, USA, to build commercial vehicle tracking computers. In 2012, Dyacon began development of a line of weather instruments. These products benefit from the Dyacon team’s extensive experience in rugged electronic design and cost-effective value. The features that Dyacon weather stations provide are unique to the industry.

## 2.4. Acurite

Acurite is a weather product selling brand in North America. They offer the technology for personal weather stations builders. However, they are expensive and cost hundreds of dollars.

# Procedures and Methods

## STEP 1: Mechanical design and construction

* Design the PCB using KiCad.
* Sensor testing.
* Assembling PCB with all the sensors.
* Continuity Testing.

## STEP 2: Data communication

* Simplex mode of data communication.

## STEP 3: User Interface

* Design the UI.
* Develop the ground station with Microsoft Visual Studio using C#.

## STEP 4: Data handling and analysis

* Create a schema for storing data efficiently.
* Data analysis and comparing with other data sources.

# Chapter 4: System Requirement Specification

## 4.1. Software Requirements

### 4.1.1. Front End Tools

**4.1.1.1. Microsoft Visual Studio:** Microsoft Visual Studio is an integrated development environment from Microsoft. It is used to develop computer programs, as well as websites, web apps, web services and mobile apps.

**4.1.1.2. C#:** C# is a general-purpose, multi-paradigm programming language encompassing strong typing, lexically scoped, imperative, declarative, functional, generic, object-oriented, and component-oriented programming disciplines.

**4.1.1.3. HTML:** HTML stands for Hyper Text Markup Language. HTML describes the structure of Web pages using markup. HTML is the building blocks of web pages.

**4.1.1.4. CSS:** Cascading Style Sheets (CSS) is astylesheet language used to describe the presentation of a document written in HTML. CSS describes how elements should be rendered on screen or on other media.

**4.1.1.5. JavaScript:** JavaScript is a lightweight, interpreted programming language. It is designed for creating network-centric applications. It is complementary to and integrated with Java. JavaScript is very easy to implement because it is integrated with HTML.

**4.1.1.6. KiCad:** KiCad is a free software suite for electronic design automation. It facilitates the design of schematics for electronic circuits and their conversion to PCB designs.

### 4.1.2. Back End Tools

**4.1.2.1. NodeJS:** Node.js is a very powerful JavaScript-based framework/platform built on Google Chrome's JavaScript V8 Engine. It is used to develop I/O intensive web applications like video streaming sites, single-page applications, and other web applications.

**4.1.2.2. MySQL:** MySQL is an open source relational database management system, enabling the cost-effective delivery of reliable, high-performance and scalable Web-based and embedded database applications.

**4.1.2.3. MongoDB:** MongoDB is a cross-platform document-oriented database program. Classified as a NoSQL database program, MongoDB uses JSON-like documents with schema. MongoDB is developed by MongoDB Inc.

## 4.2. Hardware Requirement

The hardware requirement for our project are:

**4.2.1. Arduino Uno:** The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits.

**4.2.2. Arduino Nano:** The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P. It has more or less the same functionality of the Arduino Uno. It lacks only a DC power jack and works with a Mini-B USB cable instead of a standard one.

**4.2.3. MQ- 135:** The MQ- 135 Gas sensor is mostly used for detecting   NH3, NOx, alcohol, Benzene, smoke and other harmful gas in environment. It can be used in home, industries as domestic gas leakage detector, portable gas detector and many more.

**4.2.4. DHT11:**  DHT11 module is digital humidity and temperature sensor mostly used for detecting humidity and temperature of surrounding environment and outputs a digital signal on the data pin. It is durable and has anti-interference ability.

**4.2.5. BMP180 Pressure Sensor:**  It measures the atmospheric pressure. It helps to measure environment temperature and pressure and barometric pressure.by which we can calculate altitude which can be used in various application like weather monitoring, navigation with I2C interface.

**4.2.6. Dust Sensor:** Dust Sensor Sharp’s GP2Y1010AU0F is designed to sense fine dust particles.  It allows to detect the reflected light of dust in air.

**4.2.7. Dust Sensor:** The Intenseness MPU-6050 sensor contains a MEMS accelerometer and a MEMS gyro in a single chip. It is very accurate, as it contains 16-bits analog to digital conversion hardware for each channel. Therefor it captures the x, y, and z channel at the same time.

# Chapter 5: Project Planning and Scheduling

This project is certain to demand a lot of time, concentration and effort all the way through to its completion. We are, hence, looking forward to completing the project in 10 weeks. To ensure good teamwork, we promptly divided our work and set a timetable. The following Gantt chart shows the time allocation for different aspects of our project.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Week** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| Planning |  |  |  |  |  |  |  |  |  |  |
| Study and Research |  |  |  |  |  |  |  |  |  |  |
| Design |  |  |  |  |  |  |  |  |  |  |
| Coding |  |  |  |  |  |  |  |  |  |  |
| Development |  |  |  |  |  |  |  |  |  |  |
| Testing |  |  |  |  |  |  |  |  |  |  |
| Deployment |  |  |  |  |  |  |  |  |  |  |

Figure 1: Gantt Chart

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