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A study on weather forecasting by using nano-space craft

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Abstract
In this paper, the study on weather forecasting by using nano space craft is presented. In the past two decades, a silent revolution has taken place in the space domain, leading to what today is known as "New Space." We have passed from a selected group of countries, space agencies, and big industries building, launching, and operating satellites and other spacecrafts, of a scenario in which many universities and research institutes can do it. The key of this was the definition of the "CubeSat" standard, back to 1999. In 2013, it all took off on the commercial Earth Observation sector with the first launches from two companies that are now running 100+ CubeSat constellations for optical imaging or weather prediction, with very low revisit times. Today, the same revolution is taking place in the fields of Telecommunications, and Astronomical Scientific missions. In this chapter, the evolution of the space sector is briefly revised until the arrival of the CubeSats. Then, the CubeSat intrinsic limitations are discussed as they are key to understand the development and current situation of the CubeSat sector. NASA and ESA strategies are also presented. The chapter concludes with a summary of the technology roadmap to enable the next generation of CubeSat-based missions, including satellite constellations or federations, formation flying, synthetic apertures… The work done & presented in this paper is the result of the mini-project work that has been done by the first sem engineering students of the college and as such there is little novelty in it and the references are being taken from various sources from the internet, the paper is being written by the students to test their writing skills in the starting of their engineering career and also to test the presentation skills during their mini-project presentation. The work done & presented in this paper is the report of the assignment / alternate assessment tool as a part and parcel of the academic assignment of the first year subject on nanotechnology & IoT.
Keywords: Weather, Forecast, Nano, Spacecraft, Satellite

Introduction

The climate is expected to change in the next decades due to the increase of greenhouse gases. However there isa large uncertainty in the amplitude of future global warming and even more on the consequences for the Climate regional scale which is shown in Fig. 1. Global climate models are used to predict the future evolution of the climate. However, they are still some large uncertainties in their predictions due to our imperfect knowledge on the variability of the climate system and on its response to natural external forcing. Among them, the ultraviolet (UV) solar variability is probably the most important, but the mechanisms involved are still poorly understood due to the complexity of interactions occurring between the various atmospheric layers from the ground to the thermosphere. The solar irradiance (SI) is the primary source of energy reaching the Earth atmosphere system. Never the less, neither its direct or indirect influence is able to explain the global warming over the past century (Foukal *et.al*., 32006; Foukal, 42012), and certainly not over the past 35 years (Sun and climate have been going in opposite directions) which is shown in Fig. 2, what limits the role of solar

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irradiance variation in the twentieth century global warming. On longer time scales, records of the solar radiative output become essential when addressing the question of solar variability and its link with past climate changes, in particular during the Holocene period. However, solar irradiance measurements are only available since the last three decades, which calls for the use of models over longer time scales. These total solar irradiance (TSI) reconstructions (Vieira *et.al*.,52011) rely, amongst other, on solar activity indices such as sunspot number, geomagnetic indices such as aa index, cosmogenic isotopes such as 14C or 10Be, or solar models such as flux transport models. The TSI is a crucial input for all climate models. It's very important to continue to measure this essential climate variable & is shown in Fig. 3. The use of nano-satellites offers us a unique opportunity to achieve this goal. The PICARD instruments measured a TSI around 1362 W.m−2(Meftah *et.al*.,62013), for the mean annual TSI, representative of the 2008 solar minimum. From the future mission discussed in this paper, we hope to confirm this absolute value and to continue the measurement of the total solar irradiance variability. The Active Cavity Radiometer Irradiance Monitor (ACRIM) TSI composite (http://acrim.com/)

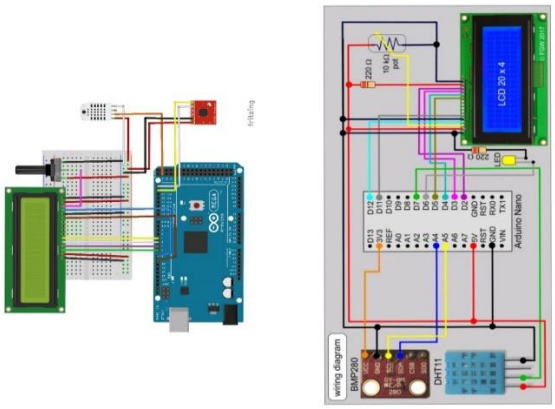

Fig. 1 : Circuit design using Arduino Uno Board

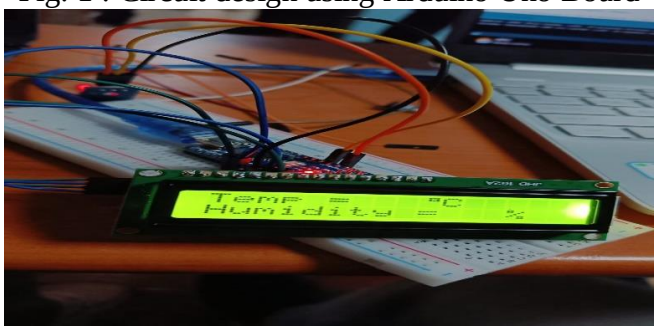

Fig. 2 : Experimental results on the 7-segment LED display

Tools used (h/w & s/w):

Arduino nano, Barometric Sensor (BMP-180), Temperature Sensor (DHT-11), LCD 16*2 display, Jumper cables, Breadboard

Results

The readings as recorded in the satellite are as follows: Atmospheric Pressure, Altitude, Temperature, Humidity, Absolute Pressure, Relative pressure.

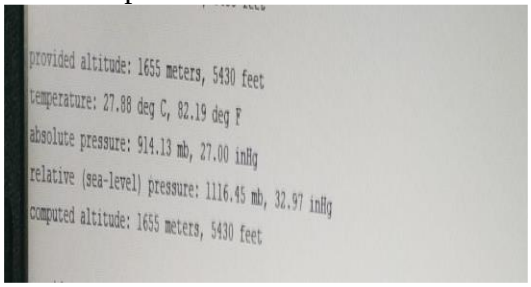

Fig. 3 : Parameters measured on the screen

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Applications

- An increase in the number of small satellite launches.
- A more prominent role for larger sized CubeSats (6U & 12U).
- Larger constellations and improved coordination between CubeSats.
- The transformation on its way thanks to artificial intelligence.
- Greater data processing and transmission capacity.
- Increased use of propulsion systems for CubeSats.
- Improvements in active and passive de-orbiting systems.
- Origami and new high-tech solutions for antennas
- Increased use of CubeSats for space exploration
- Appearance of new regulations.
- To measure the altitude from sea level.
- To measure the atmospheric pressure.
- To measure the atmospheric temperature either in Celsius nor Fahrenheit'
- To measure humidity
- They are small in size when compared to the normal satellites.
- They are light weight.
- They are more efficient in working.
- They can be modified and used for specific purposes.
- It is easier to develop.

Conclusions

Nano-satellites, also known as CubeSats, have become a valuable tool in the field of education and training for space activities. By flying these components in a CubeSat, technical maturity can be acquired at a lower cost than traditional methods such as rockets. In addition to their educational and testing capabilities, nano-satellites are also being used to perform targeted scientific missions. For example, the "nano-satellite to study the Sun and the Earth" is an ambitious scientific program that utilizes nano-technology to improve our understanding of the relationship between solar ultraviolet variability and stratospheric ozone. These small satellites are ideal for cost-effective missions that focus on technological research, low-cost science, and commercial proof-of-concept missions. In summary, nano-satellites provide an exciting opportunity for education, training, and scientific research in the field of space activities. As technology continues to advance, these small satellites will likely play an increasingly important role in our exploration and understanding of the universe.

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