INFRASTRUCTURAL DEVELOPMENT AND IMPLEMENTATION OF SOME CUBE SAT SUBSYSTEMS

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Abstract

A concerted effort is ongoing in Africa and other developing economies to develop capacity in the design and development of Cube Sat and other variants of small satellites to support research efforts for educational purposes. Africa has received considerable support in human development by UNOOSA and some developed countries. However, efforts should be made to build necessary capacity for local development of some of the subsystem of small satellite using locally sourced facilities and materials considering the financial status of an average academician/ academic institutions in developing countries to procure the commercial-off-the-shelf components. The purpose of this presentation is to aggregate the efforts made so far in achieving local production of space worthy small satellite components and highlighting necessary interventions to extend the frontiers.

Introduction

There is a noticeable gap in engineering competence for design and development of small satellite in its various forms in Africa. Except South Africa , virtually all the 54 countries that makes up Africa depend totally on developed economies for pertinent data **for economic and disaster mitigation** planning. Africa has 10 to 14 researches on small satellites out of her 54 countries. The countries that are presently into small satellite development are South Africa, Tunisia, Egypt, Ethiopia Kenya, Ghana and Nigeria. The development Activities of most of this satellite are done offshore.

- Initiatives responsibility for awareness, trainin and retraining of over 80 percent of African space science and technology experts is traceable to UNOOSA.
- CubeSat prices very high for developing countries' scientists (Kits 6000 to 7000 Dollars, Cube Sat Deplorer 1 –U is 11000 Dollars Launching 300,000 Dollars).
- UNOOSA and Big Hearts of some Developed Economies assisted African Cube sat Developers.

- The main objective of the Action Plan of African space initiative is to allow Africa make full use of the potential of space systems for sustainable development and reinforce the continent's capacity in and ownership of using and contributing to remote sensing applications.

The nine priority areas which UN assistance should address are :

(1) Long term management of natural resources.
(2) Marine and coastal management.
(3) Water resource management.
(4) Climate variability and change.
(5) Disaster risk reduction.
(6) Food security and rural development.
(7) Infrastructure and territorial development.
(8) Conflicts resolution.

Methodology

- ***Progressive development of Cube Sat subsystems***

SOME EFFORTS AT SUBSYSTEMS' DEVELOPMENT

- Development of cube sat structure(possible in many African universities with conventional machine tools like lathe, milling, shaping, drilling machines).
- Different types of antennas(microstrip patch, yagi-uda, dish), other antenna and fabricated based on relevant mathematical relationship i.e Patch Antenna which radiates primarily because of the fringing field between the patch edge and the ground plane 1.565 GHz, for GPS students' project(M Tech/PGD).
- Ultra violet photon detector (possible payload, base sub-unit for sensor systems).

- **In view, altitude determination and control with focus, first on magnetorquer.**

A. CUBESAT STRUCTURE

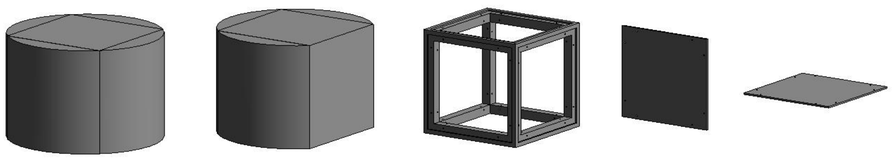
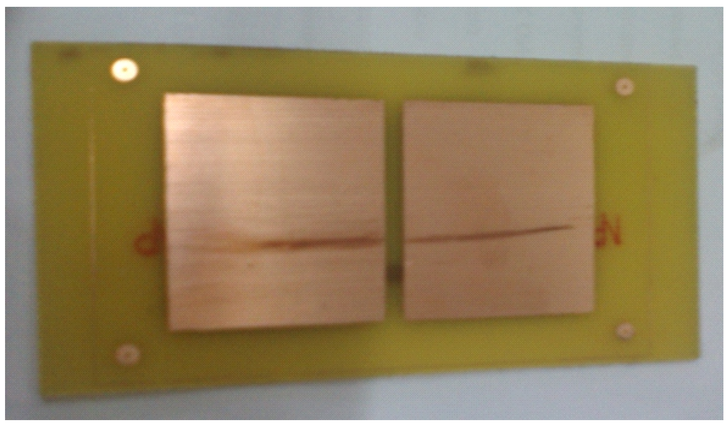


Figure 1: Development of cube sat structure

B. PATCH ANTENNA DEVELOPMENT

Figure 2.1: Improvised Set Up for UV Exposure of the Double Cladded PCB (Fluorescent lamp illuminate for 20 minutes at 30cm distance in dark room)



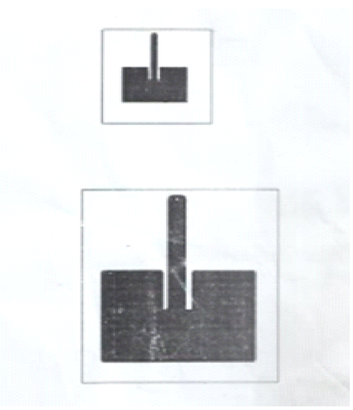


Figure 2.2: 6.2 GHz Antenna

Figure 2.3: 1.8GHz integrated to cellphone

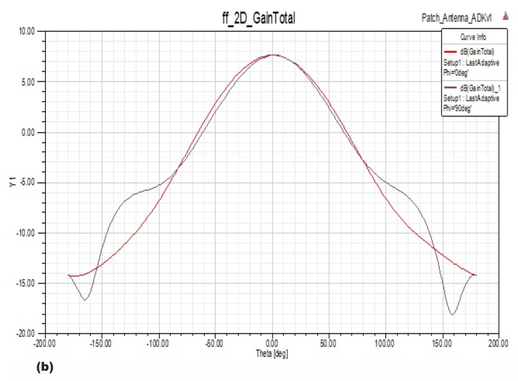
RESULTS

LOCATIONS/GPS	CELLPHONE1/ REMARK	CELL PHONE 2 / REMARK	HEIGHT ABOVE SEA LEVEL AND LATITUDE
A	6 EXCELENT	5 GOOD	7°24' 19.5" NORTH 4
B	6 EXCELENT	5 GOOD	
C	5 GOOD	4 FAIR	
D	5 GOOD	3 – 4 FAIR	
E	4 FAIR	2 - 3 FAIR	
F	4 FAIR	1–2 POOR	

Table 2.1: Performance Results of the Cellphone with Antennas

¬ -70 dBm	Excellent	6
-70 dBm to -85 dBm	Good	4-5
-86 dBm to -100 dBm	Fair	3-4
<-100 dBm	Poor	1-2

Table 2.2: Signal Strength Indicator and Signal Strength



(b)

Figure 2.4 : The gain Plots of the 1.8 GHz antenna at Theta

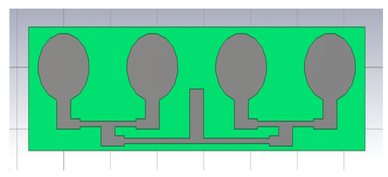


Figure 2.5: One of the other Fabricated Antennas

C. DEVELOPMENT OF UV DETECTOR AND POSSIBLE PAYLOAD

Result

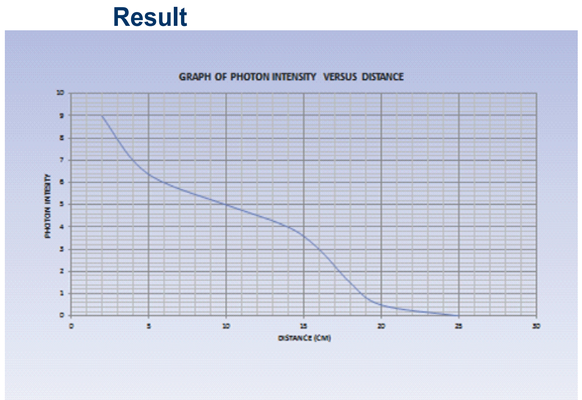


Figure 3.1 Photon intensity decaying with Distance

CONCLUSION

HIGHLIGHT OF THE NECESSARY AREAS OF INTERVENTION.

- On shore development of small satellite to promote local satellite development culture.
- Modern well equipped workshops and cub sat for regional centers for students' hands on practices.
- Test laboratories for subsystem validation.
- Test equipment: e g GHz range spectrum analyzer, vibration tester etc.
- Alumni unification /regional regular forum.
- Robust internship opportunities for trainers (to train young undergraduates).
- Areas of competence of centers should be identified and strengthened.