Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

The Design of a PocketQube Satellite Communication System

Gary Allen
23905093

August 12, 2023

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
jou kennisvennoot • your knowledge partner

Plagiaatverklaring / *Plagiarism Declaration*

1. Plagiaat is die oorneem en gebruik van die idees, materiaal en ander intellektuele eiendom van ander persone asof dit jou eie werk is.
   Plagiarism is the use of ideas, material and other intellectual property of another's work and to present is as my own.

2. Ek erken dat die pleeg van plagiaat 'n strafbare oortreding is aangesien dit 'n vorm van diefstal is.
   I agree that plagiarism is a punishable offence because it constitutes theft.

3. Ek verstaan ook dat direkte vertalings plagiaat is.
   I also understand that direct translations are plagiarism.

4. Dienooreenkomstig is alle aanhalings en bydraes vanuit enige bron (ingesluit die internet) volledig verwys (erken). Ek erken dat die woordelikse aanhaal van teks sonder aanhalingstekens (selfs al word die bron volledig erken) plagiaat is.
   Accordingly all quotations and contributions from any source whatsoever (including the internet) have been cited fully. I understand that the reproduction of text without quotation marks (even when the source is cited) is plagiarism

5. Ek verklaar dat die werk in hierdie skryfstuk vervat, behalwe waar anders aangedui, my eie oorspronklike werk is en dat ek dit nie vantevore in die geheel of gedeeltelik ingehandig het vir bepunting in hierdie module/werkstuk of 'n ander module/werkstuk nie.
   I declare that the work contained in this assignment, except where otherwise stated, is my original work and that I have not previously (in its entirety or in part) submitted it for grading in this module/assignment or another module/assignment.

Studentenommer / *Student number*	Handtekening / *Signature*
Voorletters en van / *Initials and surname*	Datum / *Date*

Contents

Declaration i

List of Figures iii

List of Tables iv

Nomenclature v

Abstract vi

1. Introduction 1

2. Problem Definition 2

2.1. Requirements 2

3. Conclusion 3

Bibliography 4

A. Appendix A 5

A.1. Project Planning Schedule 5

List of Figures

List of Tables

Nomenclature

Variables and functions

V	Voltage
I	Current
R	Resistance

Acronyms and abbreviations

GS	GroundStation
PQ	PocketQube

Abstract

English

The English abstract.

Afrikaans

Die Afrikaanse uittreksel.

1. Introduction

This project aims to design and implement a wireless communication system for a miniaturised satellite called a PocketQube (PQ). The PocketQube standard was created to define physical and electronic requirements for so-called "nano satellites". The goal of this is to allow for easy integration of various sub-modules into one physical enclosure. One common use-case of these satellites is to collect sensory information from the atmosphere. These can either be placed into orbit, are attached to a *high-altitude balloons* (e.g. a large, helium balloon). In this project, such a balloon will been provided by the department, and a communication system for this satellite balloon will be designed.

This project consists of the design of three sub-systems. The communication system to be designed will involve both a tracking ground station (GS), as well as a PQ 'unit'. The general idea is that the GS will mechanically track the PQ while it communicates with it, enabling realtime data transmission and telemetry. An existing two-axis antenna mount has been provided for the GS, which a newly-designed PCB will be placed into. The GS will mechanically the balloon, allowing bi-directional wireless communication. The PQ unit should conform to the PQ standard and fit inside a provided housing. The third sub-system is the integration of a proprietary Radiosonde (atmospheric telemetry device) into the newly-designed communication system.

Literature will be consulted in order to investigate the various design approaches and decisions. Since the project focuses on system design and integration, a number of components and sub-modules will ultimately be combined to form the final system. Different electronic components and their specifications will be compared based on gathered project requirements. This will require trade-offs to be made, since the system design is limited in time, cost, form-factor and several other factors. This report documents the trade-offs and decisions made, with the goal of being of use to future designers of similar systems.

2. Problem Definition

2.1 Requirements

The requirements for this project are defined by analysing general existing balloon-satellite systems, as well as taking into account the planned launch that this specific PQ will be used in. In these systems, the high-altitude balloons can drift to a height of around 30 km [1].

3. Conclusion

The conclusion

Bibliography

[1] "Weather Balloons — weather.gov," https://www.weather.gov/bmx/kidscorner_weatherballoons#:~:text=The%20balloon%20flights%20last%20for,20%20miles)%20in%20the%20atmosphere!, [Accessed 12-08-2023].

A. Appendix A

A.1 Project Planning Schedule

Week 01 (24/07 to 30/07): Problem formulation; requirements gathering Week 02 (31/07 to 06/08): Initial research; component selection Week 03 (07/08 to 13/08): System-level design; initial system layout; components ordered Week 04 (14/08 to 20/08): PCB design without traces; initial circuit design Week 05 (21/08 to 27/08): Component prototyping; Full circuit design; antenna design; Week 06 (28/08 to 03/09): Mechanical design; Custom protocol investigation; PCB design with traces Week 07 (04/09 to 10/09): (Test week) Week 08 (11/09 to 17/09): Initial build Week 09 (18/09 to 24/09): Software design; initial testing Week 10 (25/09 to 01/10): Software design; debugging Week 11 (02/10 to 08/10): Reporting Week 12 (09/10 to 15/10): Design improvement Week 13 (16/10 to 22/10): Testing Week 14 (23/10 to 29/10): Reporting Week 15 (30/10 to 05/11):