Thesis Title

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by

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विश्वजीवनामृतं ज्ञानम्

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CANDIDATES DECLARATION

I hereby certify that the work, which is being presented in the report, entitled **thesis title**, in partial fulfillment of the requirement for the award of the Degree of **Bachelor of Technology** and submitted to the institution is an authentic record of my own work carried out during the period *June 2022* to *September 2022* under the supervision of **Supervisor name**. I have also cited the references about the text(s)/figure(s)/table(s) from where they have been taken.

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ABSTRACT

your abstract goes here

*Keywords:*abcd,bcde....

ACKNOWLEDGEMENTS

Here’s where you acknowledge people who helped. But keep it short, i.e., not more than one page.

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ABBREVIATIONS

FIS	Fuzzy Inference System
QoS	Quality of Service
FKBC	Fuzzy Knowledge Base Controller
MOM	Middle of Maximum
SOM	Smallest of Maximum
LOM	Largest of Maximum
FIFO	First Input First Output
AQM	Active Queue Management
RREQ	Route Request
RREP	Route Reply
LW	Low
MD	Medium
HG	High
SL	Slow
FS	Fast
LS	Less
AG	Average
MR	More
VL	Very Low
VH	Very High
MF	Membership Function
trimf	Triangular Membership Function
trapmf	Trapezoidal Membership Function

NOTATIONS

$\mu_A(x)$	Membership function of crisp set A
$x_i \epsilon X$	An element x belongs to set X
$\triangleq$	Nearly equal to
max[ ]	Maximum value of variables
min[ ]	Minimum value of variables
$\wedge$	Conjunction

CHAPTER 1

Introduction

This chapter presents an overview about the context as a part of MiCas (Micro satellite et Reseau de capteur sans fils) project in section 1.1. In section 1.2 the problems and motivations are presented. Next, in section 1.3, due to the presented motivations, a research work flow is introduced step by step. Finally, in section 1.4, the research objectives are presented.

1.1 Context

The internship work is a part of MiCas project (Micro Satellite et Reseau de Capteur sans fils) in LabSTICC, UBO. Micas project objective is develop and experiment solutions to coordinate systems which will exchange data as well as control information between several distributed wireless sensor networks (WSN) and several ground stations by using low cost micro satellites. The project focus on a specification, verification and simulation of related situations : several distant WSN have their gateways visited periodically by a mobile (satellite) on a static path.

1.2 Problem/Motivation

Wireless sensor network and sensors : Wireless sensor network (WSN) is a network which implements many autonomous sensors to monitor physical or environmental conditions and passes the collection data to a main location [5]. Inside the WSN, there are many devices, named sensor can detect events or changes from environment and provides corresponding output. There are several kinds of environment data that a sensor can detect: temperature, humidity, light...[6]. In recent years, WSN is very important in environment monitoring, such as: air pollution, forest fire detection, landslide detection...
Distant WSN problem : Most of the WSN projects is deployed in city (as example

[7]), where communication systems are abundant. Otherwise, there are several WSN projects focus to the distant areas, such as shores, deserts, mountains, polar regions to monitor the environment changes. With this case, it is admitted that the radio connection from the sensor nodes to gateway can be lost or corrupted by effect of the environment. According to these problems, it is critical to propose a (several) solution(s) to collect data periodically to ensure the well operation of WSN.

Opportunities in Satellite cooperation : Obviously, with the advances in Satellites or Unmanned aerial vehicle (UAV) technologies, the solution to collect data periodically of WSN can be achieved by implement Satellite or UAV. Generally, most of the satellite systems are industrial systems and closed for the research purposes like MiCas project. Fortunately, the low earth orbit satellites (LEO satellites) [8] like CubeSat are deployed in recent years can replace the industrial satellites for the research projects i.e QB50 project, Outernet project [9, 10], Micas project because at least two reasons: energy budget and solution cost.

Cooperation problem : However, besides the advantages in cooperation between WSNs and CubeSat, there are several problems in data transaction:

- The correctly, reliable and adaptable protocols for data transaction between Satellite and WSN.
- An time event scheduler for WSN and satellite behaviors because they follow different sleeps and sampling periods.
- The limited buffering of the satellites to store and retrieve the data from ground stations.

  Research motivation As the result, for the cooperation between CubeSat and WSN, it is critical to build an application level simulation to develop and experiment the potentials as well as the risks before real deploying in environment.

1.3 Objectives

The objective of research is to approach the geo-modelisation, communication protocol development and simulation for the interaction between CubeSat and WSN. This work also relates to system investigations, based on the simulation of thousand of nodes in distant area, where CubeSat visits them, collects data, connects to ground stations and controls sensing operations. Consequently, during the internship, there are several objectives need to be achieved:

Geo-modelisation on QuickMap : To model the geo location of WSN, CubeSat trajectory and the interactions between them. Moreover, in QuickMap, it allows to generate random network topology in specified area, to record satellite path based on tracked

longitude, latitude from GPredict software (see chapter 2).
Protocol developing in Occam environment To develop the communication protocols, we propose to use Occam structure because it uses micro threads and blocking channels ([11]) which are suitable for mono and multi-processors simulation of WSN (as shown in [12]) (see chapter 3).
Protocol implementing on GPGPU : Meanwhile, the verified protocols will be implemented on GPGPU to simulate the sensing activity, the network activities, and interactions with satellites because GPGPU is attractive in synchronous message passing in WSN due to their Single Instruction Multiple Data - SIMD like architecture, shared memory (see chapter 4). In addition, it also useful to simulate the physical process due to the massive parallelism present in situations such as flooding, fires, pollution [13].

1.4 Research work flow

According to the research objectives, the report will describe the work flow as below:
Step 1 Using a map browser, QuickMap [14], to manage geo location of WSN and satellite trajectories and to model the interaction between them. A satellite tracking software, GPredict (see [15]), is used as an external process to passed the satellite paths and information to QuickMap (chapter 2)
Step 2 Using NetGen tool set [2] to generate the network topology from specification data of WSN fields and Satellite on QuickMap. The network topology can be generated into Occam structure or Compute Unified Device Architecture (CUDA) structure (chapter 2).
Step 3 Developing and analyzing the distributed protocol algorithms for the cooperation between Satellite and WSN based on generated Occam structure (chapter 3).
Step 4 Using these proposed algorithms to develop a simulation with CUDA architecture on General Purpose Graphic Processing Units (GPGPU) (chapter 4). Moreover, proposing a specific debugger interface which allows to manage the simulation execution at high level.

CHAPTER 2

Literature review

2.1 Background

2.2 Key related research

2.3 Analysis

2.4 Research gaps

2.5 Problem formulation

2.6 Conclusion

CHAPTER 3

Methodology

This section introduces the hypothesis and the analytical validation of the proposed solution.

3.1 Proposed hypothesis

3.2 Mechanism/Algorithm

3.3 Analytical validation

3.4 Conclusion

CHAPTER 4

Experiments and results

This section discusses the various experiments pertaining to the proposed hypothesis and their findings.

4.1 Experiment design

4.1.1 Experiment 1

4.1.1.1 Parameter settings

4.1.1.2 Experiment description

4.1.1.3 Results and discussion

4.1.1.4 Conclusion

4.1.2 Experiment 2

4.1.2.1 Parameter settings

4.1.2.2 Experiment description

4.1.2.3 Results and discussion

4.1.2.4 Conclusion

4.1.3 Experiment 3

4.1.3.1 Parameter settings

4.1.3.2 Experiment description

4.1.3.3 Results and discussion

4.1.3.4 Conclusion

4.2 Overall conclusion

In this section, relate the conclusions obtained in the above experiments with the gaps identified in Chapter 2. Derive conclusion about how far the set gaps were met and if not, the reason for the deviation.

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