Friedrich-Alexander-Universität Erlangen-Nürnberg
Facultiy of Engineering - Department of Electrical Engineering (EEI)
Chair of Electrical Smart City Systems

Master's Thesis
on the topic

LPWAN: Deriving the theoretical and practical limitations, and design of an application/ technology matching algorithm

by

Marcel Neugebauer
born on DD.MM.YYYY in LOCATION

to achieve the academic degree
Bachelor / Master of Science (B.Sc. / M.Sc.)

Supervisor
Prof. Dr.-Ing. Norman Franchi

03.11.2022 (Start) - 03.05.2023 (End)

Declaration

I confirm that I have written this thesis unaided and without using sources other than those listed and that this thesis has never been submitted to another examination authority and accepted as part of an examination achievement, neither in this form nor in a similar form. All content that was taken from a third party either verbatim or in substance has been acknowledged as such.

Erlangen, date

name
91054 Erlangen
address

Kurzfassung

Abstract

Introduction to an abstract thesis about the flow of space-time during the creation of any thesis.

Abbreviations and Acronyms

CEA Controlled Environment Agriculture

Contents

Chapter 1

Introduction

Lorem ipsum ... This is some sample text.
This is more sample text :). And I have even more sample text. Test.

Figure 1.1: Image caption

Lorem ipsum ...

1.1 Motivation

The motivation for this work is threefold. One, crafting ideal human environment in the context of smart city. - Taking advantage of synergies. Two, resilience and national autonomy of food supply. - Preparedness for shifting climate. Three, most important to the author, global sustainability of human civilization. - water use - pesticide use and water ?artrification? - local food production - freeing up area for natural ecosystems

?Mehr auslegen einer Vision? - Imagine the future city. Clean green walls dampen the sound of cars, provide cooling in the hot summer months.

1.2 Problem Statement

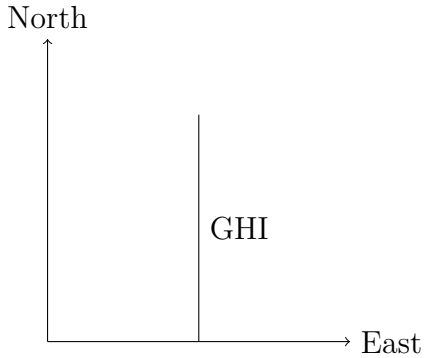
From the three main motivations laid out before we can extract the main problems of these areas. One - Air quality - disconnection from nature - buildings not properly insulated, taking advantage of synergies. Two - Reliance on a few agricultural plentiful

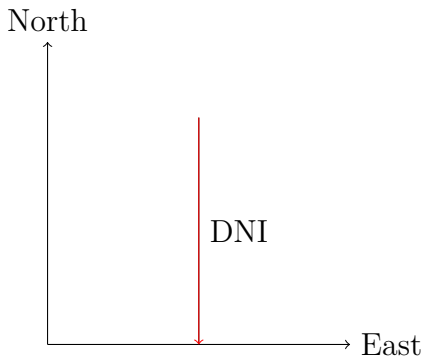
areas in the world to sustain the hunger of the human population - These might change as climate patterns will shift. Three - High resource use of cities. Uncertainty of future climate. This section laid out a number of different problems. This work can not adress all, but tries to connect

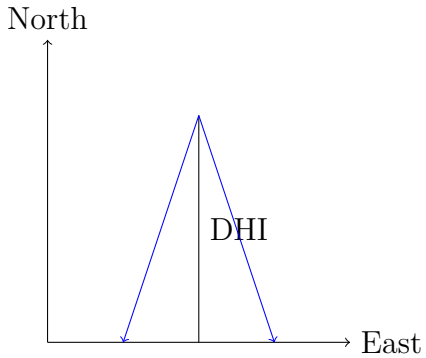
Let us first examine current Controlled Environment Agriculture (CEA) and vertical farming approaches to get a better understanding of the solution methods and shortcomings. Current solutions try to achieve high degree of automation and full control over the environment. This results in high energy

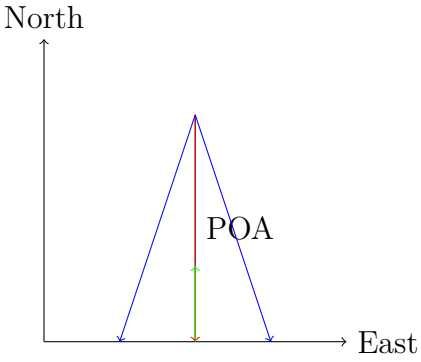
1.3 Solution Proposal

First we shall look - Gliederung der Arbeit








North
POA
East

Chapter 2

Fundamentals

2.1 Thermodynamics

2.1.1 Heat Transfer

To be able to understand the implementation of the simulation discussed later in needs ref, we first need to introduce the basics of heat transfer. There are three different forms in which heat transfer can occur. First Conduction, which describes heat moving through a solid material. This property can be characterised by the heat conductivity k for the specific material. The mathematical model equation will be introduced later with the heat capacity 2.1.2. Second we have Convection. This is heat transfer which happens between the surface of a solid material and a fluid. Last the transfer can occur via radiation. As the name implies this is basically heat energy transmitted with electromagnetic rediation. These will all be modeled seperately later. How about heat transfer via mass transfer? some sources also have advection - what's that? Difference between sensible and latent heat flow.

2.1.2 Other important thermodynamic properties

Explain Heat Capacity.

2.2 Systems Modelling Approach

2.3 Agricultural and CEA Basics

Chapter 3

Theoretical Analysis and Architectural Approach

3.1 Energy Analysis

3.2 Presentation of the General Concept

Metrics to evalute feasibility of the concept:

- The energy consumption can be met through a solar installation covering at most the area on the roof.
- Yield can offset investment costs in a reasonable timeframe.
- Farm provides measurable insulation increase in comparison with the 'naked' building.

3.3 Energy System Architecture

Chapter 4

Showcase of Example Unit and Simulation

4.1 Introduction to the Simulation Environment

4.2 Simulation Architecture

4.3 Analysis of Energy Use and Comparison with State of the Art

4.4 Results

Chapter 5

Results and Discussion

Chapter 6

Evaluation and Outlook

List of Figures

List of Tables