Growth of House Plants: Impact of light quality and intensity on speed of house plant stem and leaf growth via water propagation

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Additional Key Words and Phrases: dietary datasets, classification, machine learning, dietary prediction

ACM Reference Format:
Pourna Sengupta and Ryan Goss. 2021. Growth of House Plants: Impact of light quality and intensity on speed of house plant stem and leaf growth via water propagation. 1, 1 (March 2021), 3 pages. https://doi.org/10.1145/nnnnnnn.nnnnnnn

1 INTRODUCTION AND PROPOSED WORK

A topic of intense study and interest in within the field of computational biological modeling is that of modeling the growth, structure and architecture of plants over time. While highly complex, such applications have been explored from a multitude of perspectives for the past decades, including computer vision approaches, stochastic growth simulation and volume of growth given nutrient variables.

With a variety of perspectives and approaches within this topic area, our investigation is focused primarily on modeling the growth of common house plants in a variety of light conditions. House plants can be categorized into low, medium, bright, or broad light tolerant. Therefore, the location of the plant can affect the amount and quality of light a plant receives. Ignoring other factors that impact plant growth such as water, humidity, pot size, temperature, etc., for the purposes of this investigation the focus is understand the patterns and growth dynamics of plant growth through light quality and intensity. In particular, the project will investigate the dynamics of stem and leaf growth over time under varying conditions and analyze how these are separately impacted. We may also look at varying some plant variables such as species of modeled plant, thickness of leaves/stems and default grow rate under optimal conditions. Throughout this, our focus will be primarily on visualizing this process by monitoring change in volume, direction of growth, stemming and rate of growth.

Our goal in this work is to evaluate and improve upon previous models developed for plant growth and analyze the growth dynamics under varying lighting conditions. Figure 1 includes a brainstorm of our current approach and thinking. As might be expected, we would hypothesize that leaf growth is greatly increased by bright clear light with stem growth staying somewhat unchanged. Whereas, in low light conditions, stem growth is hypothesized to stay the same (or possibly increase in order to store nutrients) while leaf growth decreases. Additionally, the rate, directionality, volume and dynamics will be analyzed under multiple simulations. While we plan our work to be largely an organically developed effort, we may also compare our efforts to the current standard in plant [1]. We hope that such a work can serve as a template for further data mining research into this specific field of dietary intake.

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2 RELATED WORK

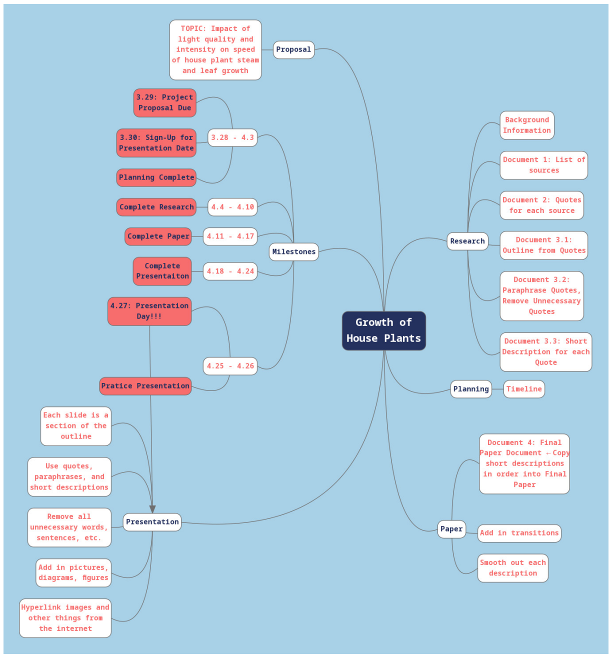

Fig. 1. Project Planning

The field of plant growth modeling is quite broad, with apparent early explorations dating back several decades. Such investigations vary in terms of focus of variables affecting growth (e.g., nutrients, oxygen/nitrogen levels, sunlight, plant species, cellular level modeling [7]) and approach (i.e., mathematical simulations [2], stochastic geometric growth modeling [5] and machine learning approaches mimicking real plant growth utilizing computer vision techniques [6]).

Most closely related to our project, several model and software approaches have been developed over time to best approximate plant growth. The first such incarnation dates back approximately two decades with software called Atelier de Modelisation de 1'Architecture des Plantes (AMAP) which is a rudimentary application for randomly generating growth of various plants via some pre-programmed template controls[4]. Since this, a more modern plan architectural and growth modeling software program has been developed, called GreenLab, originally derived from AMAP [1].

It was developed as part of a cross-functional collaboration of botonists, physiologists and mathematicians. A multitude of different plant species and parameters are available to model growth dynamics, including nutrient content, competition of resources, sunlight, etc with the ability to monitor output variables and visualize growth with computer graphics. Additionally, a number of independent modeling approaches have been employed. One such work reported successful simulation of deterministic topological development of a Mongolian Scots pine species in its native habitat within a fragile and arid ecosystem. The authors observed accurate simulation of branching and growth patterns by using a stochastic FS model [8]. A recent publication argues that while the majority of plant modeling utilizes "process-based" modeling, which emulate factors contributing to growth, a "functional-structural plant model (FSPM)" may be more flexible and refinable with an ability to tweak factors ad hoc[3].

3 MILESTONES

Our milestones for the project are as follows:

Date	Milestone	Description
Mar 28th	Initial Project Proposal	Settle on project scope and sign up for presentation
Apr 10th	Complete Research and begin Project	Finalize related work research and begin project coding and prototyping
Apr 17th	Complete initial prototyping	Fully working model/prototype of plant growth/architecture
Apr 24th	Finalize Project and Goals	Complete all project coding and modeling of plant architecture dynamics. Complete paper draft and presentation
Apr 27th	Final Project Report	Complete final goals and data analysis; complete final report

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