

ABSTRACT

OUTDOOR PLANT IDENTIFICATION AT AN OBLIQUE ANGLE

by Nathan R. Callahan

Insert your abstract here, with no indentation, and it must be a maximum of 200 words. Keep the spacing as is (single spaced). It must be one paragraph.

OUTDOOR PLANT IDENTIFICATION AT AN OBLIQUE ANGLE; NO BOLD -
USE SECOND LINE IF NEEDED-CENTERED

A Thesis (or Thesis Proposal)

Submitted to the
Faculty of Miami University
in partial fulfillment of
the requirements for the degree of
Master of Science

by

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Miami University

Oxford, Ohio

201X (current Year)

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Reader: Your Second Reader's Name

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This Thesis titled

OUTDOOR PLANT IDENTIFICATION AT AN OBLIQUE ANGLE

SECOND LINE OF YOUR TITLE IF NEEDED

by

Nathan R. Callahan

has been approved for publication by

The College of Engineering and Computing

and

The Department of Computer Science & Software Engineering

Advisor's Name

First Reader

Second Reader

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Acknowledgements

Add your acknowledgements here.

Chapter 1

Introduction

The current set of data on plant identification is geared towards direct research of machine capabilities or large scale food production and distribution. Plant identification through computer vision technologies has been primarily researched in controlled settings with specific views of the plants. This approach has value and merits but is still limited in both scope and application as most models focus on a limited number of plants or provide only a top down perspective of each plant.

Home gardeners, market gardens, and small sized farms produce a wide variety of plants using a multitude of methods. Gardens are propagated in various mediums such as raised beds, trellises, and tabled trays or towers. These plants are inspected by the caretaker at parallel and oblique angles

The goal is to build a data-set of photos and labels of garden variety plants viewed at an oblique angle, for identification in an outdoor environment. Using Machine Learning algorithms we will be testing for identification accuracy against varied plant types, for example, differentiating between a carrot plant and a beet plant, and between plant breeds, for example, differentiating a Roma tomato plant from a Beefeater tomato plant before fruiting. First we will use a binary classification of CropPlant/Invasive Plant. Determining a crop plant will allow for further categorization through labeling the plant type. A final classification will attempt to differentiate the plant type breed.

First we will use a binary classification of CropPlant/InvasivePlant. Determining a crop plant will allow for further categorization through labeling the plant type. A final classification will attempt to differentiate the plant types breed.

1. Binary Classification - Invasive Plant / Crop Plant
2. Crop identification - Tomato, Beet, Carrot, Watermelon
3. Breed identification - Roma, Beefeater, Cherry

1.1 Problem Statement

em-statement)? We describe the XXX problem as follows: ...

All problem statements include the following:

GIVEN: What is the *input* or what are the *initial conditions*

SUCH THAT: What is the scope? What are the limitations on the input that you need to impose in order to be able to solve it?

AIM: What is your *goal*? What do you want to accomplish?

CRITERIA: How can you measure whether you have done a good job? This needs to be something that you can measure. It is possible to use even subjective things like "is this fake image realistic" by using a user study – in that case criteria would be that a human user cannot distinguish real from fake images X% of the time.

It is up to you whether you call out those parts or just use POE (plain old English)

You will *probably* want to refine your problem statement to include several other sub-problems that need to be solved. These can form the basis of multiple contributions or chapters later in the work.

1.2 Contributions

Contributions)? The thesis of this work is re-word contribution 1, it will be your thesis.

In particular, we expect the following contributions:

<itm:first>

1. List your main, most important contribution here. This is the "real" one
2. List a secondary contribution. This one is likely less significant than the first one, but DO NOT admit that to ANYONE
3. And list your weakest one here. Always good to have three – try to make sure you have 3 plausible things – but the first one should be the winner

The rest of the thesis is organized as follows....

Chapter 2

Background & Related Work

2.1 Introduction

This section is where you will discuss relevant background work, and related works for comparison. Ensure that you cite references appropriately, using this as an example [1]

Dr. Femiani wants you to read examples of published literature reviews (Google for special journals devoted to them). Your aspiration or goal should be to write a lit. review as a standalone document that is capable of being published.

Some guidelines:

1. Put the `\cite{}` as close as possible to the *first* mention of the work. *Do not* put it at the end of the sentence, but instead put it right after you *first* mention the work.

Do this:

The F00 Method^{~\cite{authors}} used whozits and whatsits to do stuff.

and not this:

The F00 Method used whozits and whatsits to do stuff^{~\cite{authors}}.

An exception is if you are using a quote – but then you also have to use quotes(!).

Also when possible provide a speak-able name for a paper in addition to a citation.

You can say

the method of `\cite{authors}` was blah blah

but if I prefer to say

the method of F00^{~\cite{authors}}.

This is controversial.

2. You can put multiple bibetex keys in one `\cite{}`, and you should
3. Use `\cite[p.~150]{sample2019}` to cite a specific page.
4. Always put citations in figure captions if you copy them
5. But you should mostly make your own figures (except maybe when showing others' results in the background section)

Start by explaining:

1. Why should I read this?
 - Do you include new material not yet covered in a lit review?
 - Do you discover new connections between past work?
 - Do you cover it in a new way by giving a new interpretation?
 - Can you identify an emerging trend or anticipate future directions?
 - Do you identify gaps in the research that are ready to be explored? I hope so!
2. How did you select the topics to cover.
3. What is the criteria for something to be included
4. How is the chapter organized. Prefer to organise according to themes or methods as the demonstrates greater analytical abilities.

2.2 Overview

My preference is to use a figure such as a concept map to show how the work is connected. The figure includes sections numbers. Use InkScape (<https://inkscape.org/>) end export to PDF with LaTeX to make such a figure. See the discription of how to do this¹ In fact I would go so fat as to say **You should *start* with a concept map and a table - Use tools like freemind to build them while you collect your sources**

It is also a good idea to organize the work according to different features. Then present a table like Table 2.1. If you end up with a very big table, you can print it in landscape mode like Table 2.2 on page ??tab:big-work-compared.

¹Putting SVG figuresinto L^AT_EX is described at <http://tug.ctan.org/tex-archive/info/svg-inkscape/InkscapePDFLaTeX.pdf>.

Table 2.1: A comparison of methods

<code><tab:work-compared></code>	Approach	Feature	Feature	Feature	Feature
	Method A [1]				
	Method B [1]				
	Method C [1]				
<p>This is where authors provide additional information about the data, including whatever notes are needed.</p> <p>It is good for Dr. Femiani, who does not read the text first.</p>					

Table 2.2: A really wide comparison of methods

?(tab:big-work-compared)?	Approach	Feature	Feature	Feature	Feature
	Method A [1]	Yes, Explain	Partially, Explain	No, Explain	NA
	Method B [1]				
	Method C [1]				

This is where authors provide additional information about the data, including whatever notes are needed.
It is good for Dr. Femiani, who does not read the text first.

2.3 Background Topic 1

2.4 Background Topic 2

2.5 Discussion

Demonstrate a deep understanding of the work. Add to it by pointing out connections and relationships.

2.6 Conclusion

Conclude *this chapter* by pointing out that there is still an important gap in the current state of the art.

Chapter 3

A Lightly Edited Version of a Submitted Conference or Journal Paper

<chap:APaper>?

This is an abstract for the chapter. Explain that this chapter was submitted for publication but do not say where unless it is accepted. Include the abstract of the submitted paper in this quote.

Put the paper abstract in a second paragraph.

3.1 Introduction

Ordinarily, it is a good idea to adhere to the ‘don’t repeat yourself’ (DRY) principle. However, it is acceptable to somewhat repeat your introduction in this chapter. The important thing is that your thesis introduction in ?? should target a different audience. This introduction is aimed at experts in your field, or for people who have read and understood chapter 2, whereas ?? is for people who are new to your disciplines, such as third-year computer science students.

Consider Y, Z, W, ... all of those could be done better if X. Some people have done this or that but none have sufficiently addressed X. We propose to solve X by some different approach.

3.1.1 Contributions

We make the following contributions:

1. Copy from ??.
2. Copy from ??.
3. Copy from ??.

3.2 Prior Art

ec:prior-art)?

This is a *defense* of the *novelty* of your contributions and not a tutorial. Categorize or group methods that seem to solve a similar problem to yours, then explain why yours is still novel. It is written to convince the reader that your approach is distinct from all others.

3.3 Description Of Approach

Describe your approach in detail.

You may break this up into multiple chapters.

This is where you cite methods you *build* on rather than the methods you compete with. You should definitely have:

- An overview figure. Show a pipeline or similar that visually displays the input, key stages of your method, and the output (if such a figure is appropriate).
- Pseudocode if possible. Use the `clrs-code` package. Your description should be specific enough that someone can regenerate code that solves your problem.
- You likely want to break it into multiple figures of algorithms
- You may put mathematical proofs here, or formal definitions.

3.4 Evaluation

Describe the process used to evaluate your approach. Sometimes it is more appropriate to interleave discussions of experiments with their results, and sometimes it is more appropriate to have a separate section such as section 3.5 to present all of the results in one place. The difference is that this section explains the experimental procedures and the latter section presents the results and tells you how to interpret them.

We first describe the data used in our experiments. Then, we describe the process used to determine the validity of our approach. We use an ablation study in which a baseline method is described, and then each modification we propose is tested in order to show that it improves **whatever metric is relevant**. Finally, we compare our results against the state of the art.

3.4.1 Data

Which data will you use. How did you obtain it? How can other people obtain it? Why did you choose it? Show me some examples.

3.4.2 Validation

Compare different versions of your solutions. Describe an ablation study, or a grid search. In your approach you likely had some parameters that would change the performance. Was there a threshold somewhere? Or a weight? Describe experiments that you did to determine the value of those (results will be described in section 3.5, unless you choose to combine that with this section, which is fine).

3.4.3 Comparison to Prior Art

Compare the best version of your solution to other methods.

3.5 Results

`<sec:results>?` This may be combined and interleaved with the previous section.

Show the figures from the different experiments describe above here.

Explain where your methods is most successful, explain the expected results, explain the modes of failure for your method (do not hide these).

Table 3.1: Ablation Study

<code>?<tab:results:ablation>?</code>			Metric	
Modification 1	Model	Modification 3	Metric 1	Metric 2
no	no	x=1	1%	1%
no	no	x=2	5%	10%
no	no	x=3	15%	40%
no	yes	x=3	45%	60%
yes	yes	x=3	42%	100%

The highest value for each metric is indicated in bold.

If you explore all or a random set of values it is a grid search.

If you show only a path from the baseline to your proposed solution it is an ablation study.

3.6 Conclusion

Restate the introduction. Convince people write another paper that will cite this.

Table 3.2: Comparison of Methods

Approach	Dataset 1		Dataset 2	
	Metric 1	Metric 2	Metric 1	Metric 2
Method A [1]	—	—	—	—
Method B [1]	—	—	—	—
Method C [1]	—	—	—	—
Ours	—	—	—	—
Ours (var)	—	—	—	—

The highest value for each metric is indicated in bold.
We show two variants of our method.
This is where authors provide additional information about the data, including whatever notes are needed.
It is good for Dr. Femiani, who does not read the text first.

Chapter 4

Another Paper Goes Here

Only include this chapter if you are very productive and you are able to get two different papers ready for publication. It may be the case that you collaborate with another student, and together you are able to produce multiple papers. In that case, you will need to determine if you have the right to use that paper in the thesis. If it is decided that you include a paper that was co-authored by another student, I would like to see an author-contribution statement as an appendix. In it, you should describe your specific contributions to the chapter and come to an agreement with your co-authors that it is accurate.

Chapter 5

Conclusion

Present the following:

- summary of your work
- list of contributions
- limitations and drawbacks to your approach
- future work
- other important concluding details

Also, here's the Miami Logo to demonstrate including images in your thesis. The logo is seen in Figure 5.1.



Figure 5.1: The Miami University Logo. Use long figure captions that completely describe your figure. Tell me what you want me to notice, explain how I should interpret the results. I should understand the figure without reading the text. Layout your figure so there is no “vacuum” of empty space. Consider grouping related graphics into one figure. Also, always label your figures and notice that the caption is below the figure. Use the optional argument to caption to provide a short version in the list of figures.

fig:MiamiLogo>

Appendix A

Sample Appendix

Include data here and other details that fit appropriately in an Appendix.

You may have as many appendices as necessary, simply follow this one as a template for including more.

Appendix B

Milestones

You should describe your *realistic* plan to accomplish the work by the time you need to defend your thesis. Your plan must take into account that your advisor will need 5-10 days to review written work with you. I wrote a `\ganttwithfeedback{task}{start}{ready}{finish}` macro to use in for the Gantt chart in Figure B.1 which renders a bar in the Gantt chart with the time you need to be ready for feedback indicated. Depending on your advisor, they may prefer to meet with for a couple of sessions to review the work together, they may want a printed or PDF report which they will markup. You will need to allow time for a couple rounds of this for each task. **Do not ask for feedback on 60 pages of thesis all at once.**

B.1 Tasks

The thesis will include the following tasks:

B.1.1 Task 1: Experimental Setup

mental-setup)? At this time you have collected data that will be needed to evaluate your approach. You should have identified competing methods that you will compare against. You should have their reported results that you can use to compare against them, or access to code so you can reproduce their work on your own data. If you cannot do either, you should have reached out to the authors see if they are willing to either run their method on data you provide or if they are willing to share code via email.

In addition, you should have a *happy* test case identified. That is, a simple version of the problem that is sufficient to illustrate the benefits of your approach. This should be clear and easy to understand example and may be artificial (it is for demonstrating the behavior not evaluation). You will use this both for testing your own solution bit you will also refer to it frequently as an example in your explanation of your method.

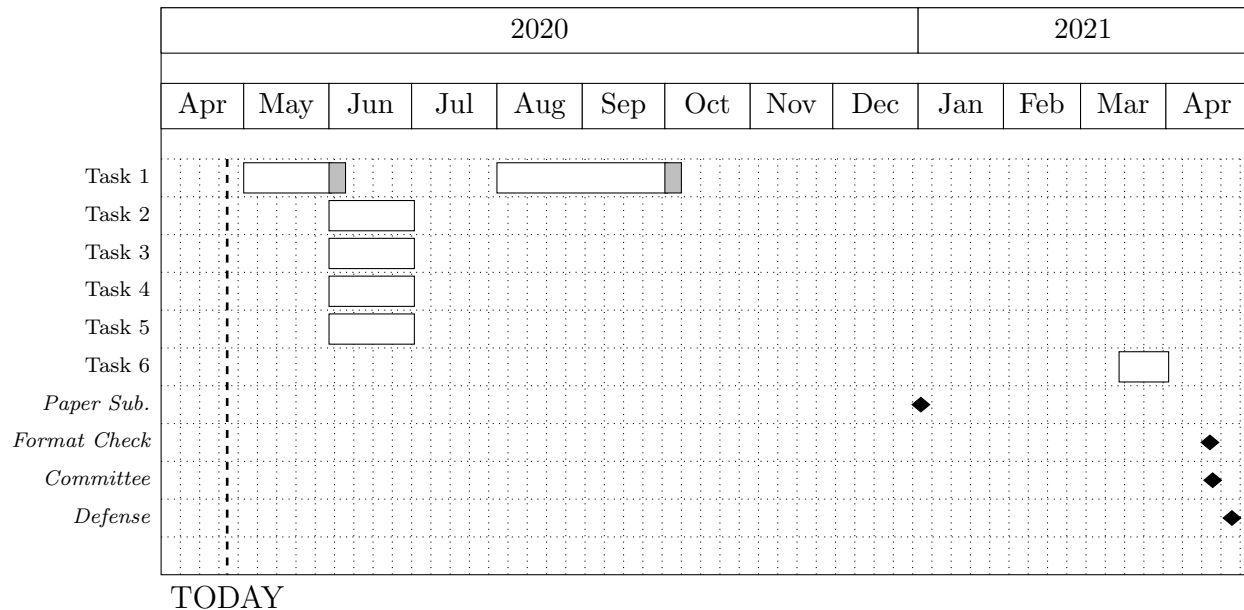


Figure B.1: Gantt chart for completion of the Thesis. Work begins as soon as the proposal is accepted and continues for one year. Each gridline in the chart represents one week. The milestones are deadlines for paper submission in addition to deadlines imposed by the university. A task is only considered done after my advisor has reviewed *and* approved it.

B.1.2 Task 2: Baseline Implementation

At this time you should have code that runs on the *Happy* test cases. You have not run experiments, but there is no additional *major* implementation needed. Unless something goes wrong during experiments, you are ready to write-up a more detailed description of your approach. Bear in mind, you will discover things during your experiments that will require you to return to this later.

B.1.3 Task 3: Complete Experiments

At this time you have run your experiments. You have collected numerical and qualitative results and put them into figures and captions in your thesis. The tables and figures have long captions or notes (see 2.1) that explain how to interpret them. You have also kept track of any caveats or decisions you had to make in order to create the results.

B.1.4 Task 4: Describe Approach

You currently have a *sketch* of your approach. You should have a written description that is complete enough that another person should be able to re-implement it. Your description must include both textual and visual representations of the approach. Visual-representations should include process diagrams or flow charts, and pseudo-code. Then you need to describe

your method with the same level of detail in text, referring back to the figures.

B.2 Milestones

B.2.1 Milestone 1: Chapter submitted for publication

You should plan to submit a chapter for publication. Ideally this is done about 4-6 weeks before your format check. In this milestone you should say *where* you plan to submit with contingencies.

B.2.2 Milestone 2: Format Check

The thesis will be sent to the to **address to send to** by **use the academic calendar**

B.2.3 Milestone 3: Thesis to Committee

The thesis will be sent to the committee by **use the academic calendar and subtract 5? or more business days from anticipated defense**

B.2.4 Milestone 4: Thesis Defense

When do you plan to do your defense?

Glossary

This document is incomplete. The external file associated with the glossary ‘main’ (which should be called `Thesis.gls`) hasn’t been created.

Check the contents of the file `Thesis.gls`. If it’s empty, that means you haven’t indexed any of your entries in this glossary (using commands like `\gls` or `\glsadd`) so this list can’t be generated. If the file isn’t empty, the document build process hasn’t been completed.

If you don’t want this glossary, add `nomain` to your package option list when you load `glossaries-extra.sty`. For example:

```
\usepackage[nomain]{glossaries-extra}
```

Try one of the following:

- Add `automake` to your package option list when you load `glossaries-extra.sty`. For example:

```
\usepackage[automake]{glossaries-extra}
```

- Run the external (Lua) application:

```
makeglossaries-lite.lua "Thesis"
```

- Run the external (Perl) application:

```
makeglossaries "Thesis"
```

Then rerun L^AT_EX on this document.

This message will be removed once the problem has been fixed.

Acronyms

This document is incomplete. The external file associated with the glossary ‘acronym’ (which should be called **Thesis.acr**) hasn’t been created.

Check the contents of the file **Thesis.acn**. If it’s empty, that means you haven’t indexed any of your entries in this glossary (using commands like `\gls` or `\glsadd`) so this list can’t be generated. If the file isn’t empty, the document build process hasn’t been completed.

Try one of the following:

- Add **automake** to your package option list when you load **glossaries-extra.sty**. For example:

```
\usepackage[automake]{glossaries-extra}
```

- Run the external (Lua) application:

```
makeglossaries-lite.lua "Thesis"
```

- Run the external (Perl) application:

```
makeglossaries "Thesis"
```

Then rerun \LaTeX on this document.

This message will be removed once the problem has been fixed.

Symbols

This document is incomplete. The external file associated with the glossary ‘symbols’ (which should be called **Thesis.sls**) hasn’t been created.

Check the contents of the file **Thesis.slo**. If it’s empty, that means you haven’t indexed any of your entries in this glossary (using commands like `\gls` or `\glsadd`) so this list can’t be generated. If the file isn’t empty, the document build process hasn’t been completed.

Try one of the following:

- Add **automake** to your package option list when you load **glossaries-extra.sty**. For example:

```
\usepackage[automake]{glossaries-extra}
```

- Run the external (Lua) application:

```
makeglossaries-lite.lua "Thesis"
```

- Run the external (Perl) application:

```
makeglossaries "Thesis"
```

Then rerun \LaTeX on this document.

This message will be removed once the problem has been fixed.

Bibliography

- sample2019 [1] I.M. Author. Sample publication in BibTeX. In *International Conference on Sample Publications (ICSP)*, pages 1–10, January 2019.