TITLE: **From the Canopy: An Arborist's Perspective**

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ABSTRACT:

The goal of this project is to enhance the visitor experience at the Morris Arboretum in the pursuit of fostering a stronger conservation ethic through the use of smartphone technology. Quick Response (QR) Codes placed on a tree identification tag will link a visitor to the created tree profiles where one can explore tree metrics, in-depth horticultural information, and multimedia content acquired in the canopy highlighting a tree climber's perspective.

TABLE OF CONTENTS

INTRODUCTION

The foundation of this project is built upon a single premise: an enhanced connection to trees will foster a stronger conservation ethic. Therefore, the goal is to deliver materials to Arboretum guests that will give them the opportunity to explore our trees in a manner not typically available.

Arborists are afforded a unique perspective on trees since their work often requires climbing into the canopy. The privilege to observe a tree from the canopy delivers a point of view entirely unlike the ground level perspective. Whether it's observing the distinctive ecology of canopy lichens or being awestruck by the view at 110 feet in the air, being in the canopy permits appreciation of the tree orders of magnitude greater than simply walking by it and it is this viewpoint, exploration, and wonder that I hope to provide for our guests.

Clearly, it is impractical to physically bring guests into the canopy with less than large capital investments like our *Out on a Limb* exhibit. To complete this goal with little or no cost, use of smartphone technology will be combined with QR Coding on tree identification tags to link a guest to our website. Each QR tag will encode for a URL that directs a guest's smartphone to a plant profile page containing useful information, pictures, and links to videos. Furthermore, generated plant profiles and associated content will be accessible from our website for any individual interested in exploring our garden remotely or studying it in a classroom.

METHODS OF CONTENT GENERATION

Plant Profile

A guest's first experience with this project will involve interacting with the plant profile page (Appendix D) that is coded with a given QR Code. This page will deliver both quick access material (tree metrics and images with seasonal interest) as well as a more in-depth, horticultural profile modeled after the "Issues in Arboretum Management" Living Collections information sheet (Appendix A).

The living collections sheet contains generalized information for one plant species. To better illustrate the individual characteristics of a specific tree, data were collected for the height, spread, and circumference at breast height (CBH). This data corresponds to trees targeted for photography, as well as nearby trees so as to keep our accession data as up-to-date as possible (Appendix B). The height measurement method employed was indicated by a letter where: (M) reflects a direct measurement using a dropped tape measure from the canopy of a tree. An advisable approach for future use of this method should involve attaching the tape measure to a 12 to 20 foot pole saw/hook and lifting it to the highest part of the canopy to increase the speed of the endeavor and decrease the danger of climbing on the thinnest branches in the upper canopy. This method is by far the most accurate but requires substantially more time. A (S) designated height assessed with the "stick trick" as advised on the Pennsylvania Big Trees website (1); refer to their site for a description of this method. Significant advantages of this method include the ability to use it from the ground, the few pieces of necessary equipment required, and the speed of execution. However, accuracy is diminished with variables like

observer error and changing topography and the method requires an open area around the measured tree, making not feasible in forested areas. Finally, the (E) designation indicates an estimated average for two observers. Admittedly, this estimate can be highly variable but when the other two methods were impossible or impractical to apply, this can provide relatively accurate information with a pair or group of practiced observers.

Pictures and Videos

Images captured during the course of this project focused on photographing both seasonal features of a given tree and attractive vistas at several heights. Images were captured with a Canon Powershot Sx230HS point-and-shoot camera. Firstly, the camera, in its protective case, was attached to the rope below the climber using a clove hitch. The targeted tree was climbed and examined for attractive vistas and interesting features. After reaching the top, the attached camera was pulled up, removed from the line, and attached to the climbing harness. Pictures were then captured from each targeted vista as the climber descended the tree.

The intent behind the videos is to provide the viewer with the sensation of both existing in a stationary position in the tree as well as moving up or down. To capture the stationary perspectives, the climber either filmed a vista with no movement so as to best capture sound and subtle tree movement, or slowly panned the camera side to side in a steady course over a duration of 30-120 seconds to gather a wider perspective. Many of the videos that used panning were rejected as a result of camera shake that resulted from free-hand shooting. Vertical transition often occurred over a distance of 5 to 7 feet where the climber slowly raised or lowered the camera, capturing the trunk of the tree along the way, and finally panning out to one side when the assent/descent was complete. These videos provide the truest sensation of traveling up and down the tree given the fixed position on the trunk during the motion.

IMPLEMENTATION

QR Code Generation and Placement

QR Codes are two dimensional matrix codes that, when incorporated into this project, represent a website URL in a format that is easily scanned by a visitor's smartphone (Appendix C). After the completion of a given tree's profile, a QR Code generator will be utilized to generate a code for placement in the garden. This code will be printed, waterproofed, and attached to either the back of a highly visible copper tree tag, or to a freestanding stake when this approach is preferred.

Smartphones and Software

The use of smartphones is essential to the execution of this project. A smartphone is defined as a cell phone with more advanced computing capability and connectivity than a traditional cell phone. The "advanced" hardware features required for this project are a working camera to scan QR Codes, internet connectivity to access website plant profiles, as well as the computing and video power to play videos and show pictures.

Possession of the appropriate software to scan QR Codes is also critical to this project. This software, given that QR Coding and use is mostly in its infancy, is not a common part of

pre-loaded software packages and, therefore, must be downloaded from the user's application store. Many applications to achieve this end are available in both free and paid versions.

Guest orientation to QR Coding and the existence of this project will be necessary after implementation. This will take the form of an informative display in the gift shop where a visitor is guided to download appropriate QR Code scanning software and is provided with a map identifying scanable plants in the garden.

CHALLENGES AND ADJUSTMENTS

Panorama Failure

As previously stated, the goal of the project was to provide our guests with a way to deepen their interaction with the Arboretum's collections. Earlier pursuits of this goal focused on the creation of 360º panoramas that would be viewable on a smart phone. The intent was to deliver to the guests some measure of control so that they might manipulate the panorama. This control was to provide the ability to pan vertically and horizontally with the hope that increased control would translate to enhanced visitor engagement.

Ultimately, this approach proved fruitless due to the lack of proper photography equipment. Using a simple point-and-shoot camera with a standard lens, combined with the inability to effectively mount a tripod in most trees, resulted in images that failed to stitch properly in several photo stitching softwares (Photoshop, Easypano, Ptgui, Panomonkey, and Panoweaver). Further investigation revealed that, despite the claims of most stitching software, only images shot with a fish-eye lens yield the sort of 360 º spherical panoramas that were necessary for the design of the project. It is my belief that using the correct DSLR camera with a fish-eye lens while shooting freehand from a tree top can create these images in the future. However, this failure was formative to the project, leading to the incorporation of videos as a substitute and potentially improving the quality of the project overall.

A Luddite's Quandary

On another note, I think it is important to address the philosophical implication of promoting the use of technology at an institution that seeks to deliver exposure to nature. One of the greatest merits of the Morris Arboretum is that, despite residing within the city of Philadelphia, our garden contains natural areas, forested trails, and open meadows that provide guests with an ecological setting not commonly granted to those living in an urban environment. If the Arboretum serves this unique function, why then would I promote the use of technology that will mar the essential immersive experience in our natural world?

I argue that it is incorrect to assume that the immersive experience of nature is innate to all humans. Not only is this argument most well illustrated by individuals raised and/or residing in an urban setting, the technological accessibility and pervasiveness of our present culture nearly mandates constant access to cell phones, computers, and the internet. The "Information Age" is aptly named, being indicative of how many in our culture orient themselves to their world. Providing these individuals with the option to gather more information about a tree through the use of their technology may be the best option to open the door to a true natural

immersion and promote an ethic of conservation. A maxim that has proven true in my own horticultural education provides a succinct summation to this point: "the more you learn, the more you can see". Therefore, it is my conclusion that, despite some arguments to the contrary, promoting the use of technology in our garden will not detract from a visitor's experience.

Seasonal Constraints

As previously stated, an important intent of this project was the inclusion of images that featured seasonal interest of particular plants. Plants are often valued for their seasonal interest. When one encounters them outside of this limited time period, they may be curious to see why this plant is valued. Capturing seasonal interest was hampered by both the weather and time frame in which the project took place. Opportunities to use snow to showcase winter interest were very limited as a result of the few snowfall events and the lack of accumulation over the entire winter of 2012. In addition, considering that the project was fully developed by November 2011 and the publication of this document occurred in April 2012, only a short window of time was available to capture seasonal interest. Expansion or continuation of this project over an entire year or over successive years will be sufficient to mitigate these limitations.

FUTURE WORK

The major product of this project is the structural foundation for designing plant profiles, making them available online, and permitting mobile access within the garden. Additionally, with the inclusion of more images, videos, and profiles, expansion to other plants, garden features, exhibits, and historical structures is easily achievable. It is my goal to complete as many tree profiles as possible before the end of this internship, but the addition of content can be supplied by any staff member or intern seeking to enhance a visitor's experience.

CONCLUSIONS

Rarely does one have the opportunity to explore and create a more fun and interesting product than this one; for this I am exceedingly thankful. Capturing each tree required climbing it and by doing this I had the privilege of exploring each one more completely than most individuals will ever have a chance to. I hope that by making the product of these climbs available to others they will gain my perspective and, through doing so, will develop a stronger connection to our trees and seek their conservation well into the future.

Finally, special thanks to my project supervisor Andrew Hawkes for his patience, training, advice, and guidance throughout this project. Additionally, Zac Brooks, Arboretum Web Master, deserves credit for all website coding and design; without either of these individual this project could never have been completed.

References

1. http://www.pabigtrees.com/Measure.aspx

APENDICES

Appendix A: Living Collections Data Sheet

Living Collections Sessions

Plant Description

Plant Scientific and common names: *Acer nigrum* - black maple

Scientific name and translation: *Acer nigrum*

Acer is the Latin name for this genus. The word also means sharp and refers to the hardness of the wood, which Romans used for spear hafts. *Nigrum* means black

Common name: black maple – perhaps because of the darkness of the foliage

Family and how it relates to this species: *Aceraceae (Sapindaceae)* – maple family (soapberry family); you can tell this because it has opposite, palmately compound leaves and samaras as fruits

Native Range and Horticultural Adaptability

Origin: Northeastern and north-central United States, including Iowa

USDA Hardiness: 3b to 7b, north of Minneapolis to Atlanta, Georgia

Horticultural Interest and Uses

Landscape uses and Characteristics (size):

Upright oval to rounded tree, 60-75 feet at maturity, useful as large-scale shade tree, boulevard tree

Cultural requirements: well-drained, moist, fertile soil; full sun

Identification traits: opposite, simple leaves, leaves three (to five) lobes, droopy, pubescent leaves, persistent stipules, long pointed buds

Seasonal interest (where appropriate):

Spring:

Summer:

Fall: excellent fall color, ranging from yellow-orange to orange-red

Winter:

Cultivars and related taxa: 'Greencolumn'

Other background

Acer nigrum is closely related to *Acer saccharum*, the sugar maple, and some people consider it a subspecies of sugar maple. It differs mostly because of the shape and pubescence of its leaves. Its range overlaps with that of sugar maple, except that sugar maple does not grow west of the Mississippi and black maple grows west of the Mississippi into Iowa and Minnesota. As a result it shows broader adaptability than sugar maple.

Appendix B: Tree Metrics Data Sheet

#	Acc. Number	Latin Name	CBH (inches)	Height (feet)	Spread (feet)
1	56-239	*Fagus engleriana*	at ground 256	60' (M)	103
2	32-0068*A	*Aesculus flava*	173	85 (M)	70
3	64-751-A	*Acer griseum*	at 2' 48	30	27
4	64-760-A	*Stewartia pseudocamelia*	31	26	23
5	32-1106-A	*Ulmus glabra cv. horizontalis*	85	22	38
6	32-0052-A	*Ulmus parvifolia*	at 2' 209	76 (S)	87
7	32-0424*A	*Pinus strobus cv. Nana*	39	23 (S)	24
8	32-0672-A	*Tsuga canadensis f. pendula*	94	31 (S)	43
9	32-0407	*Taxodium ascendens "Morris"*	78	58 (S)	23
10	32-0697-A	*Abies cilicica*	95	102 (S)	23
11	95-174-A	*Zelkova sinica*	47	55 (S)	39
12	35-6324-B	*Juniperus rigida*	56	63 (S)	22
13	35-6483-A	*Thuja occidentalis cv. DT#2*	70	60 (S)	23
14	35-5345-A	*Chamaecyparis pisifera 'Squarrosa'*	80	65 (S)	37
15	47-131-A	*Cunninghamia lanceolata*	55, 56, 41, 42, 53, 4	65 (S)	43
16	74-008-A	*Rhamnus lanceolata*	23, 27, 25, 33, 16, 17,	26 (S)	37
17	86-020-A	*Celtis choseniana*	28	17 (S)	30
18	54-0533-A	*Thuja occidentalis*	33, 20, 26, 22, 25	35 (S)	27
19	32-1122-A	*Chamaecyparis nootkatensis 'Glauca'*	54	45 (S)	23
20	32-0671-A	*Thuja occidentalis* 'Vervaeneana'	42		17
21	47-323-C	*Cedrus atlantica*	112	82 (S)	49
22	2000-110-A	*Thuja occidentalis 'emerald'*	15		4
23	32-832-A	*Pinus strobus cv. Nana*	132	46 (S)	43
24	94-490-C	*Zelkova schneideriana*	46	42	33
25	84-073-A	*Acer triflorum*	28	27	27
26	32-0090-A	*Larix kaempferi*	89	76 (S)	68
27	95-164-A	*Carpinus japonica*	21	28	20
28	32-0145 A	*Quercus x benderi*	262	85 (S)	89
29	32-0021	*Ginkgo biloba*	123	69 (S)	58
30	32-2385-A	*Quercus rubra*	180	95 (S)	66
31	32-0409-A	*Fagus sylvatica f. pendula*	114	42 (E)	29
32	32-0696-A	*Abies cephalonica*	133	102 (S)	34
33	48-022-D	*Sequoiadendron giganteum*	89	69 (S)	26
34	53-4330-A	*Sequoiadendron giganteum*	88	59 (S)	30
35	48-022-C	*Sequoiadendron giganteum*	124	73 (S)	28
36	53-194-B	*Acer griseum*	at 2': 57	45 (E)	34
37	32-0589-A	*Cercidiphyllum japonicum*	306	79 (S)	101
38	32-0864-A	*Cedrus atlantica cv. aurea*	108	59 (S)	57
39	32-0303-A	*Cedrus atlantica cv. glauca*	123	52 (E)	72
40	63-001	*Magnoila grandiflora*	at 2': 81	48 (S)	33
41	44-057-B	*Cedrus libani var. stenocoma*	101	82 (S)	32
42	32-0398-A	*Cedrus libani var. stenocoma*	150	80 (S)	56
43	32-2455-A	*Abies cilicica*	99	103	27
44	32-0697-A	*Abies cilicica*	95		25
45	49-549-A	*Metasequoia glyptostroboides*	130		34
46	49-549-B	*Metasequoia glyptostroboides*	99		26
47	49-549-C	*Metasequoia glyptostroboides*	143		31
48	49-549-D	*Metasequoia glyptostroboides*	107		38

44	32-0697-A	*Abies cilicica*	95		25
45	49-549-A	*Metasequoia glyptostroboides*	130		34
46	49-549-B	*Metasequoia glyptostroboides*	99		26
47	49-549-C	*Metasequoia glyptostroboides*	143		31
48	49-549-D	*Metasequoia glyptostroboides*	107		38
49	49-549-E	*Metasequoia glyptostroboides*	89		30
50	49-549-F	*Metasequoia glyptostroboides*	108		33
51	75-035-A	*Metasequoia glyptostroboides*	130		40
52	53-257-E	*Metasequoia glyptostroboides*	104		33
53	53-257-D	*Metasequoia glyptostroboides*	174		47
54	53-257-B	*Metasequoia glyptostroboides*	140		35
55	53-257-A	*Metasequoia glyptostroboides*	172		36
56	94-093-A	*Metasequoia glyptostroboides*	51		25
57	94-091-B	*Metasequoia glyptostroboides*	50		30
58	94-093-B	*Metasequoia glyptostroboides*	28		25
59	94-093-C	*Metasequoia glyptostroboides*	53		26
60	92-194-A	*Metasequoia glyptostroboides*	87		29
61	92-194-B	*Metasequoia glyptostroboides*	58		25
62	2003-174-A	*Metasequoia glyptostroboides*	39		21
63	32-1676-A	*Acer buergerianum*	135		73
64	32-1366	*Pteroceltis tartarinowii*	57, 62, 42, 41, 56, 70	65 (E)	71

Appendix C: QR Code

Appendix D: Online Tree Profile

Morris Arboretum of the University of Pennsylvania
Official arboretum of the Commonwealth of Pennsylvania

Great Trees

< Previous | See all Trees | See Map | Next >

Scientific Name:

Cedrus atlantica cv. 'Glauca'

Common Name:

Blue Atlas Cedar

Accession Number

32-0303*A

See more pictures and videos...

Height	CBH	Spread
56'	10'3"	70'

Naming and family

Scientific Name and Translation: *Cedrus atlantica cv. 'Glauca'* – *'Cedrus'* is derived from the Greek word "kedros", a term formally applied to both cedars and junipers, while 'atlantica' refers to the tree's native mountain range in Algeria and Morocco. 'Glauca' is derived from the ancient Greek word "glaukos" meaning "blue-grey" or "blue-green".

Common Name: Blue Atlas Cedar – The common name is accurate indicating the tree is a true cedar, originating from the Atlas mountain range. The "blue" modifier refers to the leaf color as the color is more blue/grey than the true Atlas cedar.

Family and how it relates to this species: Pinaceae- members are usually monecious, resinous, evergreen trees (except Larix and Psudolarix), with subopposite or whorled brances with spirally-arranged needles, and seeds with 3-24 cotyledons.

Native Range and Horticultural Adaptability

Origin: Turkey

USDA Hardiness: Zone 6-9

Horticultural Interest and Uses

Landscape uses and Characteristics (size): In cultivation, this tree typically grows 40'-60' tall and spreads 30'-40'. In the wild, it has the capacity to reach 120' tall and spread 90'-100'.

Cultural requirements: Prefers deep, well-drained, loamy soil with an acidic pH and full-sun exposure

Identification traits: 30-40 needle-like leaves per spur, often pointed, quadrilaterally compressed, and lustrous. Older trees develop branches with flat, shelf-like growth habit. Cones grow upward.

Seasonal interest:
Spring: growth habit, bark, evergreen foliage, beautiful and scented wood
Summer: growth habit, bark, evergreen foliage, beautiful and scented wood
Fall: growth habit, bark, evergreen foliage, beautiful and scented wood
Winter: growth habit, bark, evergreen foliage, beautiful and scented wood

Cultivars and related taxa: This is a cultivate variety of *Cedrus atlantica*. Others include 'Argentea', 'Glauca pendula', 'fastigiata', and 'Aurea'

Other background:

- Pine family has most diversity (220-250 species, 11 genera) for any conifer and the second largest geographic range (next to Cupressaceae).
- In his song "Beware the Darkness", George Harrison makes reference to this tree
- In 1995, at witches broom formed on 32-03033*A. Propagates from this formation yielded a dwarf specimen that is on display in our dwarf conifer collection located behind the greenhouses

Other pictures and videos: