Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article Dataset for Hop varieties classification

Pedro Castro, Eduardo Luz*, Gladston Moreira

Computing Department, Federal University of Ouro Preto, Ouro Preto-MG 35400-000, Brazil

ARTICLE INFO

Article history: Received 20 July 2021 Revised 14 August 2021 Accepted 19 August 2021 Available online 24 August 2021

Keywords: Hop varieties Plant recognition Leaf recognition

ABSTRACT

Humulus lupulus L., also known as hops, is a vine whose flowers are a major component in brewing. It delivers flavor, bitterness, and aroma to beer and also aids in foam stabilization. Furthermore, it plays an important role in beer conservation due to its antimicrobial and antioxidant properties, which have recently been studied for food preservation. Hops can also be found in the production of cosmetics and is considered healthy food.

There are more than 250 cataloged varieties of hops, and among the main attributes that differ from each other are alpha-acids, beta-acids, and essential oils. Those components give the beer a unique combination of characteristics, and may even influence its category. There are many ways to identify the hop variety from its acids and essential oils using methods such as chromatography, mass spectrometry, capillary electrophoresis, and nuclear magnetic resonance. However, these methods demand expensive and complex equipment, inaccessible or unavailable to most beer producers.

In this work, we present a database that includes 1592 images of hop leaves, from 12 popular hop varieties in southeastern Brazil. From these images, it is possible to explore methods of pattern recognition and machine learning to classify hop varieties

© 2021 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/)

Corresponding author.
 E-mail address: eduluz@ufop.edu.br (E. Luz).
 Social media: (E. Luz), (G. Moreira)

https://doi.org/10.1016/j.dib.2021.107312

2352-3409/© 2021 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/)







Specifications Table

Subject Specific subject area Type of data How data were acquired	Agricultural Sciences Plant variety classification Figure, text annotation Cellphone camera sensor Instruments: Motorola Moto G7, Samsung Galaxy A11 and Apple iPhone 11
Data format	JPG, XML (Pascal VOC XML Annotation Format for label and bounding box)
Parameters for data collection	The only constraint imposed on data collection was to include at least one entire hop leaf.
Description of data collection	Images were taken in a natural environment, with varying climate, light, focus, occlusion, resolution, distance, and angle. Samples contain adult and young leaves. There was no removal of outliers or low-quality images. No pre-processing was adopted either.
Data source location	Institution: Atlântica Hops City/Town/Region: Juquiá, São Paulo / Litoral Sul Paulista Country: Brazil Institution: Hops Brasil City/Town/Region: Cedral, São Paulo / São José do Rio Preto Country: Brazil Institution: Brazuca Lúpulos City/Town/Region: Petrópolis, Rio de Janeiro / Serrana Country: Brazil
Data accessibility	https://doi.org/10.6084/m9.figshare.14933178

Value of the Data

- Classify the hop variety is of paramount importance for brewers [1,2] and also other applications (cosmetic, medicinal) [3–5]. Current methods are expensive and complex [6–9]. Computer vision may be a viable path.
- The data can provide ground reference for testing and validating machine learning methods to support image classification of hop varieties. Brewers could apply these methods and try to improve the production process by better-controlling hop variety.
- This dataset is the first hop variety dataset publicly available.

1. Data Description

The UFOP Hop Varieties Dataset (UFOP-HVD) consists of 1592 images of hop leaves captured in 3 plant nurseries in Brazil. The leaf images were acquired by different people and different mobile devices (camera sensors) in order to increase the representativeness of the database. Images were taken in a natural environment, with varying climate, light, focus, occlusion, resolution, distance, and angle. Samples contain adult and young leaves. There was no removal of outliers or low-quality images. No pre-processing was adopted either. There are more than 250 cataloged varieties [10] of this plant and, among the main attributes that differ from each other, are the alpha-acids, beta-acids, and [11] essential oils. The present dataset focuses on 12 varieties popular in southeastern Brazil. Fig. 1 contains examples of each of the 12 varieties used in this dataset. Table 1 contains the number of images of each class as well as the image resolutions according to the devices (Motorola Moto G7, Samsung Galaxy A11, and Apple iPhone 11).

Each image may contain one or more leaves of a hop of the same variety. All leaves were marked with *bounding boxes* as shown in the examples in Fig. 2 and labeled by field specialists. The leaf with the largest area was labeled as main (*bounding box* red), while the others as extra leaves (in yellow). The bounding box annotations are provided with the *dataset* in the Pascal VOC XML format [12].

Resolution (pixel)									
Hop Variety	1040 × 520	1032 × 581	3391 × 2345	4096 × 2304	3683 × 3024	3024×4032	4032×3024	3072 × 4096	4096 × 3072
Cascade	51	9	0	0	1	3	46	0	0
Centennial	0	0	0	0	0	0	0	83	42
Cluster	30	0	0	23	0	0	50	0	0
Comet	55	10	0	0	0	3	47	12	44
Hallertau Mittelfrueh	0	0	0	0	0	0	0	67	74
Nugget	0	8	0	58	0	2	48	0	0
Saaz	0	7	1	0	0	1	48	39	76
Sorachi Ace	0	8	0	0	0	0	50	76	59
Tahoma	0	8	0	0	0	3	47	31	30
Triple Pearl	60	8	0	0	0	1	49	0	0
Triumph	0	9	0	42	0	5	45	0	0
Zeus	0	8	0	0	0	8	42	63	2
Total	196	75	1	123	1	26	472	371	327

Table 1				
Hop variety	distribution	per	image	resolution.

Fig. 1. Examples of the 12 Hops varieties contained in this data set: (a) Cascade; (b) Nugget; (c) Cluster; (d) Triple Pearl; (e) Hallertau Mittelfrueh; (f) Centennia; (g) Saaz; (h) Sorachi Ace; (i) Tahoma; (j) Comet; (k) Triumph; (l) Zeus.



Fig. 2. Labeling methodology: leaf with the largest area was labeled as main (red bounding box), while the others as extra leaves (yellow).

See below an example of an XML file available with the dataset:

 	1	<annotation></annotation>			
 <td>2</td><td><folder>cascade</folder></td>	2	<folder>cascade</folder>			
<pre>4 <pails.yvanuation(cstate(c)stat< td=""><td>3</td><td><pre><filename>cascade_l1_13.jpg</filename> </pre></td></pails.yvanuation(cstate(c)stat<></pre>	3	<pre><filename>cascade_l1_13.jpg</filename> </pre>			
	4	<pre><patn>/validation/cascade/cascade_11_13.jpg</patn> </pre>			
 sizes sizes sizes swidth>520 deight>1040<!--/reght--> deight>1040<!--/reght--> deight>1040<!--/reght--> deight>1040<!--/reght--> deight>11 deight>3/depth> deight>12 disizes deight deight difficult>0 difficult<0 dimin>3 difficult<0 difficult<0 difficult<0<!--</td--><td>6</td><td><database>UFOP-HVD</database></td>	6	<database>UFOP-HVD</database>			
8 <isize> 9 <vvidth>520 10 <height>1040</height> 11 <depth>3</depth> 12 13 <segmented>0</segmented> 14 <object> 15 <aname>cascade 16 <pose>Unspecified</pose> 17 <truncated>018 <difficult>0</difficult> 19 <bndbox> 20 <sumin>225</sumin> 21 <yumin>22 22 <sumax>475</sumax> 23 24 25 26 <object> 26 <object> 27 <aname>cascade 28 <pose>Unspecified</pose> 29 <truncated>0 30 <difficult>0</difficult> 31 <bndbox> 32 <sumin>1</sumin> 33 <yumax>235</yumax> 34 <<umax>238 35 <yumax>238 36 </yumax></umax></bndbox> 37 </truncated></aname></object> 38 <object> 39 <aname>cascade 40 <pose>Unspecified</pose> 41 <truncated>0 43 <sumax>238</sumax> 44 <<sumax>238</sumax> 45 <sumin>102 46 <sumax>391<<sumax> 47 <sumax>391<<sumax> 48 <<bndbox> 49 </bndbox></sumax></sumax></sumax></sumax></sumin></truncated></aname></object> 50 <object> 51 <aname>cascade</aname> 52 <pose>Unspecified</pose> 41 <truncated>0 42 <dinfficult>0 43 <bndbox> 44 <sumin>102</sumin> 45 <sumin>325 46 <sumax>391<<sumax> 47 <sumax>391<<sumax> 48 <<bndbox> 49 </bndbox></sumax></sumax></sumax></sumax></sumin></bndbox></dinfficult></truncated></object> 50 <object> 51 <aname>cascade</aname> 52 <pose>Unspecified</pose> 53 <<truncated>0 54 <<sumax>391<<sumax> 55 <<bndbox> 56 <sumin>291<<sumax> 57 <yumax>303</yumax></sumax> 58 <<sumax>428<<sumax> 59 <yumax>702</yumax></sumax> 50 <<bndbox> 51 <<aname>cascade</aname> 52 <pose>Unspecified</pose> 53 <<truncated>0</truncated></bndbox></sumax> 54 <<sumax>391<<sumax> 55 <<sumax>391<<sumax> 56 <<sumin>318<</sumin></sumax> 57 <sumax>302</sumax> 58 <<sumax>303</sumax> 59 <yumax>702</yumax></sumax> 50 < 50 < 51 <<aname>cascade</aname> 52 <pose>Unspecified</pose> 53 <<truncated>0 54 <</truncated></sumax></sumax></sumin></bndbox></sumax></sumax></truncated></object></object></yumin></bndbox></truncated></aname></object></vvidth></isize>					
9 <vidth>520 10 <height>1040</height> 11 <depth>32(depth> 12 13 <segmented>0</segmented> 14 <object> 15 <name>cascade</name> 16 <pose>Unspecified</pose> 17 <truncated>0</truncated> 18 <difficult>0</difficult> 19 <bndbox> 20 <xmin>225</xmin> 21 <ymin>225 22 <xmax>475 23 <ymax>235 24 </ymax></xmax></ymin></bndbox> 25 </object> 26 <object> 27 <name>cascade</name> 28 <pose>Unspecified</pose> 29 <truncated>0</truncated> 20 <xmin>21 21 <ymin>22.5 23 24 25 </ymin></xmin></object> 26 <object> 27 <name>cascade</name> 28 <pose>Unspecified</pose> 29 <truncated>0</truncated> 30 <difficult>0</difficult> 31 <bndbox> 32 <xmin>1</xmin> 33 <ymin>2 34 <xmax>238 35 </xmax></ymin></bndbox> 36 37 </object> 38 <object> 39 <name>cascade</name> 40 <pose>Unspecified</pose> 41 <truncated>0</truncated> 42 <difficult>0 43 <bndbox> 44 <xmin>102 45 <ymin>225</ymin> 46 <xmax>391 47 <ymax>622 48 </ymax></xmax></xmin></bndbox> 49 </difficult></object> 50 <object> 51 <name>cascade</name> 52 <pose>Unspecified</pose> 53 <truncated>0</truncated> 54 <ymin>225</ymin> 55 <bndbox> 56 <xmin>291 57 <ipose>Unspecified 53 <truncated>0 54 55 <bndbox> 56 <xmin>291 57 <ymin>280 58 <xmax> 59 <ymax>702 50 50 51 52 53 <<truncated>0</truncated> 54 <difficult>0 55 <<bndbox> 56 <<truncated>0 57 58 59 50 50 50 50 51 52 53 54 55 55 56 57 58 59 59 50 50 50 50 51 52 53 54 55 55 56 <<true< tr=""> 57 58 59 50 50 50 50 51 52 53 54 55 55 56 57 59 50 50 50 50 51 52 53 54 55 55 56 57 57 58 5</true<></truncated></bndbox></difficult></ymax></xmax></ymin></xmin></bndbox></truncated></ipose></xmin></bndbox></object></depth></vidth>	8	<size></size>			
10 <height>1040</height> 11 <depth>3</depth> 12 13 <segmented>0</segmented> 14 <0bject> 15 <namescascade< name=""> 16 >pose>Unspecified 17 <truncated>0 18 <difficult>0</difficult> 19 >bndbox> 20 <xmin>225 21 <ymin>22 23 <ymax>35 24 <b hodbox=""> 25 <lobject> 26 <object> 27 <namescascade< name=""> 28 <pose>Unspecified</pose> 29 <truncated>o 20 <xmin>1 21 <ymin>22 23 <ymax>33 24 <b hodbox=""> 25 <lobject> 26 <object> 27 <name>cascade 33 <ymin>2 34 <xmax>323 29 <truncated>o 20 <ymin>3 33 <ymin>2 34 <m< td=""><td>9</td><td><width>520</width></td></m<></ymin></ymin></truncated></xmax></ymin></name></object></lobject></ymax></ymin></xmin></truncated></namescascade<></object></lobject></ymax></ymin></xmin></truncated></namescascade<>	9	<width>520</width>			
$ \begin{array}{ll} & \langle elpth>3 < \langle ldepth>\\ 2 & \langle size>\\ 3 & \langle segmented>0 < \langle segmented>\\ 4 & \langle object>\\ 5 & \langle name>cascade < /name>\\ 6 & \langle pose> Unspecified < /pose>\\ 7 & \langle truncated>0 < \langle finiturncated>\\ 8 & \langle uifficult>0 < \langle difficult>\\ 9 & \langle bndbox>\\ 20 & \langle xmin>225 < \langle xmin>\\ 21 & \langle ymin>22 < \langle xmax>475 < \langle xmax>\\ 22 & \langle xmax>475 < \langle xmax>\\ 23 & \langle ymax>235 < /ymax>\\ 24 & \langle bndbox>\\ 25 & \langle object>\\ 26 & \langle object>\\ 27 & \langle name>cascade < /name>\\ 28 & \langle pose> Unspecified < /pose>\\ 29 & \langle truncated>0 < \langle difficult>\\ 31 & \langle bndbox>\\ 32 & \langle xmin>1 < /xmin>\\ 33 & \langle ymin>2 < /ymin>\\ 33 & \langle ymin>2 < /ymin>\\ 34 & \langle xmax>238 < /max>\\ 35 & \langle ymax>257 < /ymax>\\ 36 & \langle bndbox>\\ 37 & \langle \langle bbject>\\ 38 & \langle object>\\ 39 & \langle name>cascade < /name>\\ 40 & \langle pose> Unspecified < /pose>\\ 41 & \langle truncated>0 < /truncated>\\ 42 & \langle uifficult>0 < /uifficult>\\ 43 & \langle bndbox>\\ 44 & \langle xmin>102 < /xmin>\\ 45 & \langle ymin>22 < /ymin>\\ 45 & \langle ymin>22 < /ymin>\\ 46 & \langle xmax>391 < /xmax>\\ 47 & \langle ymax>602 < /ymax>\\ 48 & \langle bndbox>\\ 44 & \langle xmin>102 < /xmin>\\ 45 & \langle ymin>22 < /ymin>\\ 48 & \langle bndbox>\\ 44 & \langle xmin>102 < /xmin>\\ 45 & \langle ymin>22 < /ymin>\\ 48 & \langle bndbox>\\ 44 & \langle xmin>102 < /xmin>\\ 45 & \langle ymin>22 < /ymax>\\ 48 & \langle bndbox>\\ 56 & \langle xmax>391 < /xmax>\\ 59 & \langle ymax>702 < /ymax>\\ 50 & \langle bindbox>\\ 56 & \langle xmin>291 < /xmin>\\ 57 & \langle ymin>250 < /min>\\ 58 & \langle xmin>291 < /xmin>\\ 59 & \langle ymax>702 < /ymax>\\ 60 & \langle bindbox>\\ 61 & \langle bindbox>\\ 62 & \langle bindbox>\\ 63 & \langle xmin>318 < /xmin>\\ 69 & \langle ymin>71 & \langle ymax>890 < /ymax>\\ 71 & \langle ymax>890 < /ymax>\\ 72 & \langle bindbox>\\ 74 & \langle annotation>\\ 74 & \langle annotatio$	10	<height>1040</height>			
2 13 <segmented>0</segmented> 14 <object> 15 <name>cascade</name> 16 <pose>Unspecified</pose> 17 <truncated>0 <truncated>0 18 <difficult>0</difficult> 19 <bndbox> 20 <xmin>225 21 <ymin>225 22 <xmax>475 23 <ymax>235 24 <bndbox> 25 <lobject> 26 <object> 27 <name>cascade</name> 28 <pose>Unspecified</pose> 29 <truncated>o 20 <ifficult>0 31 <bndbox> 32 <xmin>1 33 <ymin>2 34 <max>238 35 <ymax>237 36 <bndbox> 37 <lobject> 38 <object> 39 <name>cascade</name> 40 <pose>Unspecified</pose> 41 <truncated>o</truncated></object></lobject></bndbox></ymax></max></ymin></xmin></bndbox></ifficult></truncated> <</object></lobject></bndbox></ymax></xmax></ymin></xmin></bndbox></truncated></truncated></object>	11	<depth>3</depth>			
13 <segmented>0</segmented> 14 <object> 15 <name>cascade </name> 16 <pp>>pose> 17 <truncated>o 18 <difficult>0</difficult> 19 <bndbox> 20 <xmin>225 21 <ymin>22. 23 <ymax>235 24 <bndbox> 25 <lobject> 26 <object> 27 <name>cascade</name> 28 <pp>>pose> 29 <truncated>o 20 <truncated>o 31 <bndbox> 32 <xmin>1 33 <ymin>2 34 <bndbox> 35 <ymax>257 36 <bndbox> 37 38 <bndbox> 39 <name>cascade </name> 40 <pp>se> 41 <truncated>o 42 <difficult>o 43 <bndbox> 44 <xmin>102 45 <pmin><td>12</td><td></td></pmin></xmin></bndbox></difficult></truncated></pp></bndbox></bndbox></ymax></bndbox></ymin></xmin></bndbox></truncated></truncated></pp></object></lobject></bndbox></ymax></ymin></xmin></bndbox></truncated></pp></object>	12				
14 <object> 15 <name>cascade</name> 16 <pose>Unspecified</pose> 17 <truncated>0. 18 <diffcult>0.</diffcult> 19 <bndbox> 20 <mmin>225 21 <ymi>22/ymin> 22 <max>475 23 <ymax>235 24 25 26 <object> 27 <name>cascade 28 <pose>Unspecified</pose> 29 <truncated>0. 21 <ymi>22. 28 <pose>Unspecified</pose> 29 <truncated>0. 20 <mi>1 21 <hndbox> 22 <mi>xax>235 23 <ymi>24. 24 <hndbox> 25 26 27 <name>cascade 28 <pose>Unspecified</pose> 29 <truncated>0. 30 </truncated></name></hndbox></ymi></mi></hndbox></mi></truncated></ymi></truncated></name></object></ymax></max></ymi></mmin></bndbox></truncated></object>	13	<segmented>0</segmented>			
15 < -name>cascade 16 < -pose>Unspecified 17 < truncated>0 18 < difficult>0 19 20 < xmin>225 21 < ymin>22 23 < ymax>235 24 25 27 < name>cascade 28 < pose>Unspecified 29 < truncated>0 18 20 19 21 < cmin>1 11 22 12 19 22 12 10 23 13 24 25 14 26 15 27 < name>cascade 28 < pose>Unspecified 29 <truncated>0 10 20 13 21 22 14 23 15 24 25 15 27 < name>cascade 28 <pose>Unspecified</pose> 29 <truncated>0 11 20 15 21 22 15 23 24 25 15 26 27 16 27 28 29 29 <truncated>0 15 20 20 21 22 23 24 25 15 26 27 27 28 29 29 20 20 21 22 22 23 24 25 26 27 27 28 29 29 20 20 20 21 22 22 23 24 25 26 26 27 27 28 29 29 29 20 20 20 21 21 22 23 24 25 26 26 27 27 28 28 29 29 29 20 20 20 20 20 21 21 22 22 23 24 24 25 26 27 27 28 29 29 20 20 20 20 20 21 21 21 22 23 24 24 25 26 27 27 28 28 29 29 20</truncated></truncated></truncated>	14	<object></object>			
17 <truncated>0. 17 <truncated>0. 18 <difficult>0.</difficult> 19 <bndbox> 20 <xmin>225. 21 <ymin>22. 23 <ymin>22. 24 25 26 <object> 27 <name>cascade </name> 28 <pose>Unspecified</pose> 29 <truncated>0. 20 <difficult>0.</difficult> 31 <bndbox> 32 <min>1<</min></bndbox></truncated></object></ymin></ymin></xmin></bndbox></truncated></truncated>	15	<name>cascade</name>			
18 >difficult>0 19 >bndbox> 20 <xmin>225 21 <ymin>2.5 22 <xmax>475 23 <ymax>235 24 25 26 <0bject> 27 <name>cascade </name> 28 <pose>Unspecified</pose> 29 <tmcated>0 21 22 <xmin>10 23 <ymin>2 24 25 26 <0bject> 27 <name>cascade </name> 28 <pose>Unspecified</pose> 29 <tmcated>0 31 <br <="" td=""/><td>17</td><td><pre><pre>cpose>onspecifica</pre>//pose></pre></td></tmcated></ymin></xmin></tmcated></ymax></xmax></ymin></xmin>	17	<pre><pre>cpose>onspecifica</pre>//pose></pre>			
9 <min>225</min> 21 <min>225 22 <max>475 23 <ymax>235 24 25 26 <object> 27 <name>cascade</name> 28 <pose>Unspecified</pose> 29 <truncated>0 21 28 <pose>Unspecified</pose> 29 <truncated>0 20 <truncated>0 21 20 <min>1 31 <br <="" td=""/><td>18</td><td><difficult>0</difficult></td></min></truncated></truncated></truncated></object></ymax></max></min>	18	<difficult>0</difficult>			
20 < xmin>225 21 < ymin>24 < ymin>24/ymin> 22 < xmax>245 23 < ymax>235 24 25 27 < name>cascade 28 <pose>Unspecified</pose> 29 <truncated>0</truncated> 30 <difficult>0</difficult> 31 <bndbox> 32 < xmin>1 33 <ymin>2 34 < xmax>238 35 <ymax>257</ymax> 36 </ymin></bndbox> 37 38 <object> 39 <name>cascade</name> 40 <pose>Unspecified</pose> 41 <truncated>0</truncated> 42 <difficult>0</difficult> 43 <bndbox> 44 <xmin>102</xmin> 45 <ymin>225 46 <symax>257 47 <ymax>622</ymax> 48 <</symax></ymin></bndbox> 44 <xmin>102</xmin> 45 <ymin>20 46 <xmax>391 47 <ymax>622</ymax> 48 49 </xmax></ymin></object> 50 <object> 51 <name>cascade</name> 52 <pose>Unspecified</pose> 53 <truncated>0 54 55 <bndbox> 48 </bndbox> 49 </truncated></object> 50 <object> 51 <name>cascade</name> 52 <pose>Unspecified</pose> 53 <truncated>0 54 <difficult>0</difficult> 55 <bndbox> 48 49 </bndbox></truncated></object> 50 <object> 51 <name>cascade</name> 52 <pose>Unspecified</pose> 53 <truncated>0 55 <dobdox> 56 <xmin>291<</xmin></dobdox></truncated></object>	19	 bndbox>	21 $< ymin>2 / ymin>$ 22 $< xmax>475 / ymax>$ 23 $< ymax>235 / ymax>$ 24 $< /bndbox>$ 25 $< /object>$ 26 $< object>$ 27 $< name>cascade $ 28 $< pose>Unspecified $ 29 $< truncated>0 - /truncated>$ 30 $< difficult>0 - /difficult>$ 31 $< bndbox>$ 32 $< xmin>1 < /xmin>$ 33 $< ymin>2 < /ymin>$ 34 $< xmax>238 $	20	<xmin>225</xmin>
19	 bndbox>				
21 $< ymin>2 / ymin>$ 22 $< xmax>475 / ymax>$ 23 $< ymax>235 / ymax>$ 24 $< /bndbox>$ 25 $< /object>$ 26 $< object>$ 27 $< name>cascade $ 28 $< pose>Unspecified $ 29 $< truncated>0 - /truncated>$ 30 $< difficult>0 - /difficult>$ 31 $< bndbox>$ 32 $< xmin>1 < /xmin>$ 33 $< ymin>2 < /ymin>$ 34 $< xmax>238 $					
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	21	<ymin>2</ymin>			
23 $<$ ymax>235 24 $<$ /bndbox> 25 $<$ /bject> 26 $<$ object> 27 $<$ name>cascade 28 $<$ pose>Unspecified/e/pose> 29 $<$ truncated>0 30 $<$ diffcult>0 31 $<$ bndbox> 32 $<$ xmin>1 33 $<$ ymin>2 34 $<$ xmax>238 35 $<$ ymax>257 36 $<$ /bndbox> 37 $<$ /object> 38 $<$ object> 39 $<$ name>cascade 40 $<$ pose>Unspecified 41 $<$ truncated>0 42 $<$ diffcult>0 43 $<$ bndbox> 44 $<$ xmin>102 45 $<$ ymin>2525 46 $<$ xmax>391 47 $<$ ymax>622 48 $<$ /bndbox> 44 $<$ xmin>102 45 $<$ ymin>255 50 $<$ object> 50 $<$ object> 51 $<$ name>cascade 52 $<$ pose>Unspecified 53 $<$ truncated>0 54 $<$ diffcult>0 55 $<$ bndbox> 56 $<$ xmin>291 57 $<$ ymin>580 58 $<$ xmax>428 59 $<$ ymin>2580 50 $<$ object> 50 $<$ object> 51 $<$ name>cascade 52 $<$ pose>Unspecified 53 $<$ truncated>0 54 $<$ diffcult>0 55 $<$ bndbox> 56 $<$ xmin>291 57 $<$ ymin>580 58 $<$ xmax>428 59 $<$ ymax>702 59 $<$ ymax>702 50 $<$ object> 51 $<$ name>cascade 52 $<$ object> 53 $<$ truncated>0 54 $<$ object> 55 $<$ bndbox> 56 $<$ truncated>0 57 $<$ ymin>280 58 $<$ xmin>291 59 $<$ ymax>702 50 $<$ object> 51 $<$ name>cascade 50 $<$ truncated>0 50 $<$ ymax>702 51 $<$ chiftoult>0 52 $<$ object> 53 $<$ truncated>0 54 $<$ pose>Unspecified 55 $<$ truncated>0 56 $<$ truncated>0 57 $<$ ymin>71 $<$ ymax>890 58 $<$ xmin>72 $<$ object> 59 $<$ ymax>72 $<$ object> 50 $<$ truncated>0 50 $<$ truncated>0 51 $<$ chiftout 52 $<$ object> 53 $<$ truncated>0 54 $<$ pose>Unspecified 55 $<$ truncated>0 56 $<$ truncated>0 57 $<$ ymin>70 $<$ true> 58 $<$ truncated>0 59 $<$ ymax>702 $<$ ymax> 50 $<$ ymin>70 $<$ true> 50 $<$ true> 51 $<$ true> 52 $<$ object> 53 $<$ true> 53 $<$ true> 5	22	<xmax>475</xmax>			
24 25 26 <object> 27 <name>cascade </name> 28 <pose>Unspecified </pose> 29 <truncated>-0./truncated> 30 <difficult>-0.</difficult> 31 > 32 <min>1 33 <ymin>2 34 <max>238 35 <ymax>257 36 37 38 <object> 39 <name>cascade </name> 40 <pose>Unspecified </pose> 41 <truncated>-0. 42 <difficult>-0</difficult> 43 <br <="" td=""/><td>23</td><td><ymax>235</ymax></td></truncated></object></ymax></max></ymin></min></truncated></object>	23	<ymax>235</ymax>			
25 26 <0bject> 27 <name>cascade</name> 28 <pose>Unspecified</pose> 29 <truncated>0 29 <truncated>0 21 <smin>1 22 <smin>1 23 <smin>2 34 <smax>238 35 <pmax>257 36 <pose>Unspecified</pose> 37 <pose> 38 <object> 39 <name>cascade</name> 40 <pose>Unspecified</pose> 41 <truncated>0 42 <difficult>0</difficult> 43 <pose>Unspecified</pose> 44 <smin>102</smin> 45 <pmin>22 46 <smax>391 47 <pmax>622</pmax> 48 </smax></pmin></truncated></object></pose></pmax></smax></smin></smin></smin></truncated></truncated>	24				
20 21 <	25				
21 $<$ chain > Labore () function > 22 22 $<$ pose>Unspecified < pose> 23 $<$ difficult> 0 < / difficult> 31 $<$ bndbox> 32 $<$ xmin>1 < / xmin> 33 $<$ ymin>2 < / ymin> 34 $<$ xmax> 238 < / xmax> 35 $<$ ymax> 238 < / ymax> 36 $<$ / bndbox> 37 $<$ / object> 38 $<$ object> 39 $<$ name> cascade < / name> 40 $<$ pose> Unspecified < / pose> 41 $<$ truncated> 0 < / truncated> 42 $<$ difficult> 0 < / difficult> 43 $<$ bndbox> 44 $<$ xmin>102 < / xmin> 45 $<$ ymin> 232 < / ymin> 46 $<$ xmax> 391 < / xmax> 47 $<$ ymax> 622 < / ymax> 48 $<$ / bndbox> 44 $<$ xmin>102 < / xmin> 45 $<$ ymin> 232 < / ymin> 46 $<$ xmax> 391 < / xmax> 47 $<$ ymax> 622 < / ymax> 48 $<$ / bndbox> 49 $<$ / object> 50 $<$ object> 51 $<$ name> cascade < / name> 52 $<$ pose> Unspecified < / pose> 53 $<$ truncated> 0 < / truncated> 54 $<$ difficult> 0 < / difficult> 55 $<$ bndbox> 56 $<$ xmin> 291 < / xmin> 57 $<$ ymin> 580 < / ymin> 58 $<$ xmax> 428 < / xmax> 59 $<$ ymax> 702 < / ymax> 60 $<$ / bndbox> 61 $<$ 62 $<$ object> 63 $<$ name> cascade 64 $<$ pose> Unspecified 65 $<$ truncated> 0 64 $<$ pose> Unspecified 65 $<$ truncated> 0 64 $<$ pose> Unspecified 65 $<$ truncated> 0 64 $<$ pose> Unspecified 65 $<$ truncated> 0 66 $<$ difficult> 0 67 $<$ bndbox> 68 $<$ xmin> 318 69 $<$ ymin>71 $<$ ymax> 890 71 $<$ 73 $<$ 74 $<$ /annotation>	20	<pre><0Dject> <pre><pre>cscode </pre></pre></pre>			
29 <truncated>0-/truncated> 30 <difficult>0-//tincated> 31 struncated>0-/truncated> 32 <xmin>1=/xmin> 33 <ymin>2=/ymin> 34 <xmax>238 35 <ymax>237 36 bodox> 37 struncated>0-/truncated> 40 <pose>Unspecified</pose> 41 <truncated>0-/truncated> 42 <difficult>0-/difficult> 43 struncated>0-/truncated> 44 <xmin>102 45 <ymin>325 46 <xmax>391 47 <ymax>622</ymax> 48 bodox> 49 50 <object> 51 <name>cascade</name> 52 <pose>Unspecified</pose> 53 <truncated>0-/truncated> 54 <difficult>0-/difficult> 55 boldox> 56 <xmin>291 57 <ymin>580 58 <xmax>428 59 <ymax>702 58 <truncated>0-/truncated> 54 <difficult>0-/difficult> 55 boldox> 61 62 < 63 <name>cascade</name> 64 <pose>Unspecified</pose> 63 <truncated>0-/truncated> 64 <pose>Unspecified</pose> 65 <truncated>0-/truncated> 64 <pose>Unspecified</pose> 65 <truncated>0-/truncated> 64 <pose>Unspecified</pose> 65 <truncated>0-/truncated> 64 <pose>Unspecified</pose> 65 <truncated>0-/truncated> 64 <pose>Unspecified</pose> 65 <truncated>0-/truncated> 64 <pose>Unspecified</pose> 65 <truncated>0-/truncated> 64 <pose>Unspecified</pose> 70 <xmax>472 71 <ymax>890 72 73 73 73 73 73 73 73 73 73 73 73 73 73 73 73 74 74 74 74 74 74 74 </ymax></xmax></truncated></truncated></truncated></truncated></truncated></truncated></br></truncated></br></difficult></truncated></ymax></xmax></br></ymin></xmin></difficult></truncated></object></br></br></xmax></ymin></xmin></difficult></truncated></br></br></ymax></xmax></ymin></xmin></difficult></truncated>	28	<pre><name>caseade</name></pre>			
30 <difficult>0./difficult> 31 <bndbox> 32 <xmin>1</xmin> 33 <ymin>2</ymin> 34 <xmax>238 35 <ymax>257 36 </ymax></xmax></bndbox> 37 38 <object> 39 name>cascade 40 <pose>Unspecified</pose> 41 <truncated>0. 42 <difficult>0</difficult> 43 <bndbox> 44 <xmin>102 45 <ymin325< td=""> 46 <xmax>391 47 <ymax>622 48 49 41 <truncated>- 42 43 <bndbox> 44 <xmin>102 45 <ymin>2 46 <xmax>391 47 <ymax>622 48 49 40 51 <name>cascade 52 <bndbox> 53 <td< td=""><td>29</td><td><truncated>0</truncated></td></td<></bndbox></name></ymax></xmax></ymin></xmin></bndbox></truncated></ymax></xmax></ymin325<></xmin></bndbox></truncated></object></difficult>	29	<truncated>0</truncated>			
31 > l 32 <min>l</min> 33 <ymin>l 34 <max>238 35 <ymax>257 36 37 38 <object> 39 -name>cascade 39 -name>cascade 40 <pose>Unspecified</pose> 41 41 <min>102 42 <difficult>0</difficult> 43 >ohdbox> 44 <min>102 45 <ymin>225 46 <max>391 47 <ymax>622 48 49 51 <name>cascade 52 <pose>Unspecified</pose> 53 <tmin>24 54 <difficult>0 55 <br <="" td=""/><td>30</td><td><difficult>0</difficult></td></difficult></tmin></name></ymax></max></ymin></min></min></object></ymax></max></ymin>	30	<difficult>0</difficult>			
32 <xmin>1</xmin> 33 <ymin>2 34 <xmax>238 35 <ymax>257 36 37 37 38 <object> 39 <name>cascade</name> 40 <pose>Unspecified</pose> 41 <truncated>0 42 <difficult>0</difficult> 43 <bndbox> 44 <xmin>102 45 <ymin>325 46 <max>391 47 <ymin>202 48 <lood> 50 <object> 51 <name>cascade 53 <truncated>0 </truncated></name></object></lood></ymin></max></ymin></xmin></bndbox></truncated></object></ymax></xmax></ymin>	31	 bndbox>			
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	32	<xmin>1</xmin>			
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	33	<ymin>2</ymin>			
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	34	<xmax>238</xmax>			
36 (object> 37 (object> 38 <object> 39 <name>cascade </name> 40 <pose>Unspecified</pose> 41 <truncated>0 42 <difficult>0</difficult> 43 symin>102 44 <min>102 45 <ymin>325 46 <max>391</max> 47 <ymax>622 48 49 48 49 40 <max>20 50 <object> 51 <name>cascade </name> 52 <pose>Unspecified</pose> 53 <truncated>0 54 <difficult>0</difficult> 55 <br <="" td=""/><td>35</td><td><ymax>257</ymax></td></truncated></object></max></ymax></ymin></min></truncated></object>	35	<ymax>257</ymax>			
38 <0bject> 39 <name>cascade </name> 40 <pose>Unspecified</pose> 41 <truncated>0 42 <diffcult>0 43 <bndbox> 44 <min>102 45 <ymin>225 46 <xmax>391 47 <ymax>622 48 49 40 <pose> 50 <object> 51 <name><cascade <="" name=""> 52 <pose> 53 <truncated>>0 54 <diffcult>o</diffcult> 55 <bndbox> 56 <xmin>291 57 <ymin>580 58 <ymin> 59 <ymax>702 60 61 62 <object> 63 <name> 64 <pose> 65 <truncated> 66 <diffcult>o 67 <bndbox> 68 <min>318 69 <ymin>717 69 <ymin>718 60 61 62 63 64 <t< td=""><td>36</td><td></td></t<></ymin></ymin></min></bndbox></diffcult></truncated></pose></name></object></ymax></ymin></ymin></xmin></bndbox></truncated></pose></cascade></name></object></pose></ymax></xmax></ymin></min></bndbox></diffcult></truncated>	36				
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	38				
40 <.pose_Unspecified 41 <truncated>0 42 <difficult>0</difficult> 43 <.bndbox> 44 <xmin>102</xmin> 45 <.ymin>325 46 <.ymax>391 47 <.ymax>622 48 49 50 <object> 51 <name>cascade</name> 52 <.pose>Unspecified 53 <truncated>0 54 <difficult>0</difficult> 55 <.bndbox> 56 <xmin>291</xmin> 57 <.ymin>580 58 <xmax>428</xmax> 59 <.ymax>702 60 61 <.object> 62 <.object> 63 <-name>cascade 64 <.pose>Unspecified 65 <truncated>0 56 <xmin>318 63 <.name>cascade 64 <.pose>Unspecified 65 <.truncated>0 57 58 59 50 50 50 51 52 53 54 55 56 57 57 58 59 50 50 50 50 51 52 53 54 55 55 56 57 57 58 59 50 50 50 51 52 53 54 55 55 56 57 58 59 59 50 50 50 50 51 52 53 54 55 55 56 57 57 58 59 50 50 50 50 51 52 53 53 54 55 55 56 57 57 58 59 50 50 50 50 50 50 51 51 52 53 53 54 55 55 56 57 50 50 50 51 51 52</xmin></truncated></truncated></object></truncated>	39	<pre><object> </object></pre>			
41 <truncated>0</truncated> 42 <difficult>0</difficult> 43 <bndbox> 44 <min>102</min> 45 <ymin>325</ymin> 46 <max>391</max> 47 <ymax>622</ymax> 48 </bndbox> 49 40bject> 50 <object> 51 <name>cascade</name> 52 <pose>Unspecified</pose> 53 <truncated>0 54 <difficult>0</difficult> 55 <bndbox> 56 <xmin>291 57 <ymin> 58 <xmax>428 59 <ymax>702</ymax> 60 61 62 <object> 63 <name> 64 <pose>Unspecified</pose> 65 <tmcated>0</tmcated> 64 <pose>Unspecified</pose> 65 <tmcated>0</tmcated> 64 <pose>Unspecified</pose> 65 <tmcated>0</tmcated><td>40</td><td><pre><pre><pre><pre>clicitied</pre></pre></pre></pre></td></name></object></xmax></ymin></xmin></bndbox></truncated></object>	40	<pre><pre><pre><pre>clicitied</pre></pre></pre></pre>			
$\begin{array}{rcl} 42 & 0 \\ 43 & \\ 44 & 102 \\ 45 & 225 \\ 46 & 391 \\ 47 & 622 \\ 48 & \\ 49 & \\ 50 & \\ 51 & cascade \\ 52 & Unspecified \\ 53 & 0 & 56 & 291 & 57 & 880 \\ 58 & 702 \\ 59 & 702 \\ 59 & 702 \\ 60 & \\ 61 & \\ 63 & cascade \\ 64 & Unspecified \\ 65 & 291 \\ 70 & 428 \\ 71 & 188 \\ 70 & 18 \\ 70 & 18 \\ 71 & 890 \\ 72 & \\ 73 & \\ 74 & \\ 74 & \\ 74 & \\ 74 & \\ 75 & $	41	<truncated>0</truncated>			
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	42	<difficult>0</difficult>			
	43	 hdbox>			
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	44	<xmin>102</xmin>			
46 <xmax> 391</xmax> 47 <ymax>622</ymax> 48 49 50 <object> 51 <name>cascade</name> 52 <pose>Unspecified</pose> 53 <truncated>o 54 <difficult> 0</difficult> 55 <bndbox> 56 <xmin>291 57 <ymin>580 58 <xmax>428 59 <ymax>702 60 61 62 <object> 63 <name>cascade </name> 64 <pose>Unspecified</pose> 65 <truncated>o 64 <pose>Unspecified</pose> 65 <truncated>o 66 <diffcult>o</diffcult> 67 <bndbox> 68 <min>318 69 <ymin> 70 <maxa×472< td=""> 71 <ymax>890 72 73 74</ymax></maxa×472<></ymin></min></bndbox></truncated></truncated></object></ymax></xmax></ymin></xmin></bndbox></truncated></object>	45	<ymin>325</ymin>			
47 <ymax>622<ymax> 48 <ylondbox> 49 50 <object> 51 <name>cascade</name> 52 <pose>Unspecified</pose> 53 <truncated>0</truncated> 54 <diffcult>0</diffcult> 55 <bndbox> 56 <xmin>291</xmin> 57 <ymin>80</ymin></bndbox></object></ylondbox></ymax> 59 <ymax>702</ymax> 60 61 63 <name>cascade</name> 64 <pose> 65 <truncated>0 56 66 <diffcult>0</diffcult> 67 <bndbox> 68 <xmin>318 69 <ymin>71 57 58 59 59 50 50 50 50 50 50 51</ymin></xmin></bndbox></truncated></pose></ymax>	46	<xmax>391</xmax>			
 <	47	<ymax>622</ymax>			
43 50 <0bject> 51 <name>cascade</name> 52 <pose>Unspecified</pose> 53 <truncated>0 54 <difficult>0</difficult> 55 <bndbox> 56 <xmin>291 57 <ymin>580 58 <xmax>428 59 <ymax>702 60 61 62 <object> 63 <name> 64 <pose>Unspecified</pose> 65 <truncated>0 66 <difficult>0 67 <bndbox> 68 <min>318 69 <ymin>717 69 <ymax>472 71 <ymax>472 72 73 73 74</ymax></ymax></ymin></min></bndbox></difficult></truncated></name></object></ymax></xmax></ymin></xmin></bndbox></truncated>	40	/object>			
51 <name> cascade </name> 52 <pose> Unspecified </pose> 53 <truncated> 0-/truncated> 54 <dificult> 0-/dificult> 55 <bndbox> 56 <min>291 57 <ymin>80 58 <max>428 59 <ymax>702 60 71 63 <name>cascade </name> 64 <pose> Unspecified</pose> 65 <truncated>0- 64 <pose> Unspecified</pose> 65 <truncated>0- 66 <diffcult>0-</diffcult> 67 <bndbox> 68 <min>318 69 <ymin>318 70 <max>472 71 <ymax>890 72 73 73 74</ymax></max></ymin></min></bndbox></truncated></truncated></ymax></max></ymin></min></bndbox></dificult></truncated>	50	<object></object>			
$\begin{array}{llllllllllllllllllllllllllllllllllll$	51	<name>cascade</name>			
53 <truncated>0 54 <difficult>0</difficult> 55 <bndbox> 56 <xmin>291</xmin> 57 <ymin>580</ymin> 58 <xmax>428</xmax> 59 <ymax>702</ymax> 60 </bndbox> 61 52 <object> 63 <name>cascade 64 <pose> 65 <truncated> 66 <diffcult>0 67 <bndbox> 68 <xmin>318 69 <ymin>717 70 <xmax>472 71 <ymax>890 72 73 74</ymax></xmax></ymin></xmin></bndbox></diffcult></truncated></pose></name></object></truncated>	52	<pre><pose>Unspecified</pose></pre>			
54 <difficult>0</difficult> 55 <bndbox> 56 <min>291</min> 57 <ymin>580</ymin> 58 <max>428</max> 59 <ymax>702</ymax> 60 </bndbox> 61 62 <bdyett> 63 <name> 64 <pose>Unspecified</pose> 65 66 <difficult> 67 <bndbox> 68 <min>318 69 <ymin>717 <max>472 71 <ymax>490 72 73 74</ymax></max></ymin></min></bndbox></difficult></name></bdyett>	53	<truncated>0</truncated>			
55 <bdbox> 56 <min>291</min> 57 <ymin>S80</ymin> 58 <max>428</max> 59 <ymax>702</ymax> 60 </bdbox> 61 62 <object> 63 <name> 64 <pose>Unspecified</pose> 65 66 <difficult> 67 <bndbox> 68 <min>318 69 <ymin>717 70 <max>472 71 <ymax>890 72 73 74</ymax></max></ymin></min></bndbox></difficult></name></object>	54	<difficult>0</difficult>			
56 <xmin>291</xmin> 57 <ymin>580</ymin> 58 <xmax>428</xmax> 59 <ymax>702</ymax> 60 61 62 <object> 63 <name>cascade </name> 64 <pose>Unspecified</pose> 65 <truncated> 66 <difficult>0 67 <bndbox> 68 <xmin>318 69 <ymin>171<</ymin></xmin></bndbox></difficult></truncated></object>	55	 bndbox>			
57 <ymin>300</ymin> 58 <xmax>428</xmax> 59 <ymax>702</ymax> 60 61 62 <object> 63 <name>cascade </name> 64 <pose> 65 <truncated> 66 <difficult> 67 <bndbox> 68 <xmin>318 69 <ymin>318 70 <xmax>472 71 <ymax>890 72 73 74</ymax></xmax></ymin></xmin></bndbox></difficult></truncated></pose></object>	56	<xmin>291</xmin>			
59 59 60 61 62 <object> 63 <name>cascade </name> 64 <pose> Unspecified </pose> 65 <truncated> 0 66 <diffcult> 0</diffcult> 67 <bndbox> 68 <mmin>318 69 <ymin>717 70 <mmax>472 71 <ymax>890 72 73 74</ymax></mmax></ymin></mmin></bndbox></truncated></object>	57	<ymin>580</ymin>			
55 Symax/302/ymax/s 60 (bject> 61 (object) 62 <object> 63 <-name>cascade 64 <pose>Unspecified</pose> 65 <truncated>o 66 <difficult>o 67 69 <pmin>318 68 <<mmin>318</mmin> 69 <ymin>717 70 <mmax>472 71 <ymax>890 72 73 <</ymax></mmax></ymin></pmin></difficult></truncated></object>	50	$< \times 100$ $\times 100$ $< \times 100$ $\times 100$			
 	60	/bndbox>			
62 <object> 63 <name>cascade </name> 64 <pose>Unspecified</pose> 65 <truncated>>0 66 <difficult> 67 <bhdbox> 68 <xmin>318 69 <ymin>17 70 <xmax>472 71 <ymax>890 72 73 74</ymax></xmax></ymin></xmin></bhdbox></difficult></truncated></object>	61				
63 -name>cascade 64 <pose> Unspecified </pose> 65 <truncated> 0 66 <diffcult> 0</diffcult> 67 <bndbox> 68 <min>318 </min> 69 <ymin>717 </ymin> 70 <max>472 </max> 71 <ymax>890 72 </ymax></bndbox> 73 74</truncated>	62	<object></object>			
64 <pre>cyse>Unspecified</pre> 65 <pre><truncated>0 66 <pre><diffcult>0 67 <pre> 68 <pre><min>318</min> 69 <pre><min>318</min> 69 <pre><min>318</min> 70 <pre><max>472</max></pre><pre><max></max></pre> 71 <pre><max>890</max></pre><pre><pre>72 </pre><pre><pre><pre><pre><pre><pre><pre><</pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></diffcult></pre></truncated></pre>	63	<name>cascade</name>			
65 <truncated>0 66 <difficult>0</difficult> 67 <bndbox> 68 <min>318</min> 69 <ymin>717</ymin> 70 <xmax>472 71 <ymax>890 72 </ymax></xmax></bndbox> 73 74</truncated>	64	<pose>Unspecified</pose>			
66 <difficult>0</difficult> 67 <bndbox> 68 <xmin>318</xmin> 69 <ymin>717</ymin> 70 <xmax>472</xmax> 71 <ymax>890</ymax> 72 </bndbox> 73 74	65	<truncated>0</truncated>			
67 <bndbox> 68 <xmin>318</xmin> 69 <ymin>717</ymin> 70 <xmax>472</xmax> 71 <ymax>890</ymax> 72 </bndbox> 73 74	66	<difficult>0</difficult>			
os <xmin>318</xmin> 69 <ymin>717</ymin> 70 <xmax>472</xmax> 71 <ymax>890</ymax> 72 73 74	67	 bndbox>			
05 <ymm> 70 <xmax>472</xmax> 71 <ymax>890</ymax> 72 73 74 </ymm>	60	<xmin>318</xmin>			
71 <ymax>890</ymax> 72 73 74	69 70	<ymin>/1/</ymin> <ymay>472</ymay>			
72 73 74	70	890			
73 74	72	/bndbox>			
74	73				
	74				

We emphasize that each XML refers to an acquired image and that it can contain more than one leaf and consequently more than one bounding box annotation. The XML presented corresponds to the left image of Fig. 2.

From the original *dataset*, a new one was generated containing all the leaves cut by the *bounding boxes*. This other set of data is called Cropped Dataset. The number of leaves per class in this database and the average of extracted leaves per image are displayed in Table 2.

Table 2

Cropped Dataset description.

Hop Variety	Number average extracted leaf / image	Number total leaf / variety
Cascade	3,76	414
Centennial	1,62	202
Cluster	4,36	449
Comet	1,88	321
Hallertau Mittelfrueh	1,65	232
Nugget	3,81	442
Saaz	2,05	353
Sorachi Ace	2,02	390
Tahoma	2,30	274
Triple Pearl	3,53	417
Triumph	3,77	381
Zeus	2,31	284
Total	2,61	4159

2. Experimental Design, Materials and Methods

The database is divided into three sets of data (70% for training, 15% for validation and 15% for test) in order to standardize the evaluation of machine learning methods. The division can be seen in Tables 3 and 4.

Table 3

Number of images of each class for each of the partitions (train, validation, test), in dataset without pre-processing.

Hop Variety	# Train	# Validation	# Test	Total
Cascade	78	16	16	110
Centennial	89	18	18	125
Cluster	73	15	15	103
Comet	121	25	25	171
Hallertau Mittelfrueh	99	21	21	141
Nugget	82	17	17	116
Saaz	122	25	25	172
Sorachi Ace	137	28	28	193
Tahoma	85	17	17	119
Triple Pearl	84	17	17	118
Triumph	71	15	15	101
Zeus	87	18	18	123
Total	1128	232	232	1592

Since the database is unbalanced in terms of images per class, results must be reported using recall, precision and F1-score per class.

Table 4

Number of leaves of each class for each of the partitions (train, validation, test), in Cropped Dataset.

Hop Variety	# Train	# Validation	# Test	Total
Cascade	318	39	57	414
Centennial	158	23	21	202
Cluster	316	58	75	449
Comet	212	52	57	321
Hallertau Mittelfrueh	165	30	37	232
Nugget	301	74	67	442
Saaz	265	40	48	353
Sorachi Ace	286	43	61	390
Tahoma	203	32	39	274
Triple Pearl	299	56	62	417
Triumph	260	56	65	381
Zeus	196	48	40	284
Total	2979	551	629	4159

Ethics Statement

Not applicable.

CRediT Author Statement

Pedro Castro: Conceptualization, Data curation, Writing–original draft; **Eduardo Luz**: Conceptualization, Experimental Design, Writing-Reviewing and editing; **Gladston Moreira**: Conceptualization, Writing-Reviewing and editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have, or could be perceived to have, influenced the work reported in this article.

Data Availability

UFOP Hop Varieties Dataset (UFOP-HVD) (Original data) (figshare).

Acknowledgments

The authors would like to thank Atlântica Hops, Hops Brasil and Brazuca Lúpulos for providing the images, Lúpulo Zona da Mata for technical contribution and UFOP for their financial support.

References

G. Astray, P. Gullón, B. Gullón, P.E. Munekata, J.M. Lorenzo, Humulus lupulus l. as a natural source of functional biomolecules, Appl. Sci. 10 (2020) 5074.

- [2] C. Almaguer, C. Schönberger, M. Gastl, E.K. Arendt, T. Becker, Humulus lupulus-a story that begs to be told. a review, J. Inst. Brew. 120 (2014) 289–314.
- [3] T. Nuutinen, Medicinal properties of terpenes found in cannabis sativa and humulus lupulus, Eur. J. Med. Chem. 157 (2018) 198–228.
- [4] L. Chadwick, G. Pauli, N. Farnsworth, The pharmacognosy of humulus lupulus l.(hops) with an emphasis on estrogenic properties, Phytomedicine 13 (2006) 119–131.
- [5] P. Zanoli, M. Zavatti, Pharmacognostic and pharmacological profile of humulus lupulus l, J. ethnopharmacol. 116 (2008) 383–396.
- [6] M. Kovačevič, M. Kač, Determination and verification of hop varieties by analysis of essential oils, Food Chem. 77 (2002) 489–494.
- [7] R.A. Shellie, S.D. Poynter, J. Li, J.L. Gathercole, S.P. Whittock, A. Koutoulis, Varietal characterization of hop (humulus lupulus l.) by gc-ms analysis of hop cone extracts, J. Sep. Sci. 32 (2009) 3720–3725.
- [8] M.A. Farag, E.A. Mahrous, T. Lübken, A. Porzel, L. Wessjohann, Classification of commercial cultivars of humulus lupulus l.(hop) by chemometric pixel analysis of two dimensional nuclear magnetic resonance spectra, Metabolomics 10 (2014) 21–32.
- [9] L.M. Duarte, L.H.C. Adriano, M.A.L. de Oliveira, Capillary electrophoresis in association with chemometrics approach for bitterness hop (humulus lupulus l.) classification, Electrophoresis 39 (2018) 1399–1409.
- [10] J. Healey, The Hops List: 265 Beer Hop Varieties From Around the World, Julian Healey, 2016.
- [11] B. Steenackers, L. De Cooman, D. De Vos, Chemical transformations of characteristic hop secondary metabolites in relation to beer properties and the brewing process: a review, Food Chem. 172 (2015) 742–756.
- [12] M. Everingham, J. Winn, The pascal visual object classes challenge 2012 (voc2012) development kit, Pattern Analysis, Statistical Modelling and Computational Learning, Tech. Rep 8 (2011) 5.