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Background

- Yeast may induce neurobehavioral changes in the hippocampus.
- Hippocampal-related memory and recognition affected in behavioral tasks (spatial working memory).
- Current methods are labor-intensive or impractical for practical situations.
- The automated segmentation process is prone to interaction errors.
- No automated segmentation technique is available.
- The TIC-SNAP offers an ideal tool for automatic and manual segmentation.
- Robust tool for clinicians, researchers, and technicians outside the computer programming.
- Design a protocol to reliably measure the volume of the rat hippocampus from the TIC-SNAP interface.

Project Illustration

Objective and Design Challenges

Objective: To develop a robust, semi-automatic computer method that determines the volume of the rat hippocampus from a magnetic resonance image.

Specifications:
- Inter- and intra-rater reliability of at least 0.90, as measured by the Dice overlap coefficient.
- Reduction of rat hippocampal volume difference of less than 20% between image sets.
- Segmentation of hippocampal put under 60 minutes.

Risks:
- Artifactual boundaries of the rat hippocampus.
- Errors in the flow due to a reduction in the hippocampal size.
- Errors in training adjusted to the region of interest.

Constraints:
- No sensitivity.
- Small sample size (N=4).
- Training in software functionality.

Results: Segmentation Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Cerebral Hemispheres</th>
<th>Cerebral Hemisphere</th>
<th>Cerebral Hemisphere</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebral Hemispheres</td>
<td>0.90</td>
<td>0.95</td>
<td>0.89</td>
</tr>
<tr>
<td>Cerebral Hemisphere</td>
<td>0.92</td>
<td>0.94</td>
<td>0.91</td>
</tr>
<tr>
<td>Cerebral Hemisphere</td>
<td>0.93</td>
<td>0.95</td>
<td>0.92</td>
</tr>
</tbody>
</table>

Results: Volume Measurements

<table>
<thead>
<tr>
<th>Image</th>
<th>Rater 1 (Volume)</th>
<th>Rater 2 (Volume)</th>
<th>Rater 3 (Volume)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75.2 ± 0.51</td>
<td>74.1 ± 0.71</td>
<td>75.9 ± 0.45</td>
</tr>
<tr>
<td>2</td>
<td>78.7 ± 0.08</td>
<td>78.7 ± 0.79</td>
<td>78.5 ± 0.81</td>
</tr>
<tr>
<td>3</td>
<td>74.7 ± 0.31</td>
<td>74.8 ± 0.83</td>
<td>78.7 ± 0.70</td>
</tr>
<tr>
<td>4</td>
<td>78.9 ± 0.44</td>
<td>78.9 ± 1.76</td>
<td>78.8 ± 0.57</td>
</tr>
</tbody>
</table>

Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Promised</th>
<th>Delivered</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>Inter-rater reliability of at least 0.90</td>
<td>Inter-rater reliability of 0.90</td>
<td>Data coefficients calculated using UNI-SNAP segmentation algorithm</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>Deletion of hippocampal volume difference of at least 5%</td>
<td>Deletion of hippocampal volume difference of 0%</td>
<td>hippocampal volume difference of 0%</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>Deletion of hippocampal volume difference of less than 5%</td>
<td>Deletion of hippocampal volume difference of 5%</td>
<td>hippocampal volume difference of 5%</td>
</tr>
<tr>
<td>Time Optimization</td>
<td>&lt; 00 minutes</td>
<td>40.50 ± 1.12 minutes</td>
<td>40.50 ± 1.12 minutes</td>
</tr>
</tbody>
</table>

Conclusions and Recommendations

Conclusions:
- A segmentation protocol was developed for the rat hippocampus in MRI images.
- The protocol allows for consistent volume measurements between raters, and between measurements from the same rat.

Recommendations:
- Modify the TIC-SNAP interface to improve manual segmentation portion of the segmentation process.
- Use the segmentation protocol on MRI images from isoflavone-exposed rats.

Acknowledgements
We would like to thank Dr. Lynne Schwartz and Dr. James Gee for their guidance and support throughout this senior design project.