Radius Teknologies, LLC Uses LabVIEW to Aid Mental Rotation Research Study

"Using LabVIEW, Radius Teknologies, LLC developed and deployed a powerful, versatile, intuitive, and easy-to-use solution within extremely tight deadlines and on budget—something that we could not have achieved using another development platform."—Mark Ridgley, Radius Teknologies, LLC

Industry:
Academic

Application:
Neuropsychology

The Challenge:
Gathering reaction time data from subjects performing a mental rotation task within the constraints of a short development time and a limited budget.

The Solution:
Developing the Reaction Time application to support a neuropsychology pilot study employing a mental rotation task to examine the effects of mental fatigue, as induced by the mental rotation task, on-task performance, strategy, and brain function.

Author(s):
Mark Ridgley, Radius Teknologies, LLC

Understanding the Study of Mental Rotation

The task of mental rotation describes the ability of a subject to rotate mental representations of two or three dimensional objects. Primarily used to study the speed of spatial information processing and intelligence, mental rotation studies how the brain manipulates visual stimuli (an object or image in the subject's environment) to understand what the object or image is and where it belongs. The stimulus is then altered in some controlled way, whereupon mental rotation takes place and the subject is asked to determine how the original stimulus was modified. The task of mental rotation can be separated into the following stages[1]:

1. Create a mental image of an object
2. Rotate the object mentally until axial orientation allows comparison to the standard
3. Make the comparison
4. Decide whether the objects are the same
5. Report the decision

Company Background

Radius Teknologies, LLC was established as an NI Alliance Partner and independent LabVIEW consulting company in 2013. We are dedicated to helping companies be successful using NI hardware and software to design, develop, and implement creative, versatile, and sustainable solutions to complex technical challenges in measurement, automation, and control. We have experience designing, developing, and implementing test systems based on NI hardware and software for the academic, consumer, medical, automotive, industrial, and aerospace/military markets.

Reaction Time Application

The Reaction Time application could be used to support research to understand the task of mental rotation. The application needed to present a visual stimulus on a screen that would change based on user inputs, provide millisecond precision timing, work on a variety of OSs, and output the data file in a way that would be easy to analyze using the IBM SPSS Statistics software package. Furthermore, we needed to work with the customer remotely due to the compressed timeframe and the physical distance between the customer and the development team. We communicated with the customer through phone calls, emails, and online file sharing. The delivered application is visually pleasing, with an intuitive user interface that met all customer requirements. In addition, the application eliminated the need for the customer to generate the numerous image files required to execute the

experiment by providing functionality wherein the application generates images based on information entered into a control file prior to executing the experiment. We extended application functionality at a later time by adding the ability for the application to use spoken words to add an auditory dimension to the study stimuli. A second extension marked the "mental rotation button press" events in the electroencephalogy data so that brain wave activity could be time-locked to the mental rotation task.

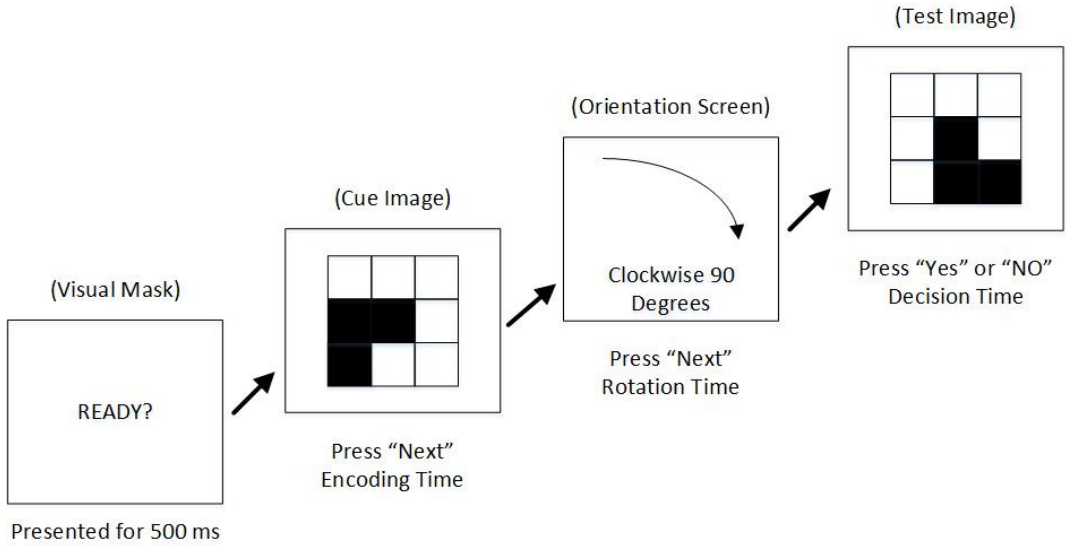

Figure 1. *Mental Rotation Primary Task Schematic*

Mental Rotation Primary Task

For the mental rotation, the system presented an image (cue) on-screen. Participants were told to study this image until they had it in memory, and then press "Next". This displayed the orientation screen, which indicated the direction and number of degrees needed to rotate the image into the 0 degree position. Once the 0 degree image was held in memory, participants were to press "Next" again. One of two images (test) appeared on the screen. If the image was the correct image in the 0 degree position, participants were to press "Yes"— indicating that this image matched the one held in memory. If it was the mirror image, they were to press "No"—indicating that the presented image did not match the one held in memory. Brain wave activity was recorded throughout task completion with electroencephalography (EEG) using the International 10-20 setup.

A Flexible, Complete Solution with LabVIEW

Radius Teknologies, LLC has more than 16 years experience developing applications based on LabVIEW. As an NI Alliance Partner, we are strong advocates of the LabVIEW software development environment.

Using the LabVIEW software development environment, we worked remotely with the customer, primarily via phone calls, emails, and online file sharing. LabVIEW made it easy and fast to produce the intuitive and unobtrusive GUIs that this customer required. We were able to quickly prototype and refine the GUIs to execute the experiments as desired and acquire the necessary study data, all while "not getting in the way" of either the researchers conducting the study or their subjects.

Finally, because LabVIEW supports a wide range of equipment and OSs, we were able to use the customer's existing equipment and computer systems to implement the Reaction Time application. We could deliver a complete solution that met all of the customer's needs without compromising the limited project budget.

Conclusion

With LabVIEW, Radius Teknologies, LLC designed, developed, and deployed a versatile, intuitive, and easy-to-use solution on time and within budget—something we could not have achieved using other development platforms.

Our customer uses the Reaction Time application successfully, without experiencing any problems or unexpected behavior. LabVIEW was clearly a great choice for this unique and demanding application.

1. Johnson, A.M., "Speed of Mental Rotation as a Function of Problem Solving Strategies," *Perceptual and Motor Skills* 71 (1990), 803-806.

Author Information:
Mark Ridgley
Radius Teknologies, LLC
9401 Inverness Ln. NW
Ramsey, MN 55303
763.438.0322
mark.ridgley@radius-tek.com
www.radius-tek.com

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