

Exploring Ways to Engage Children with Cerebral Palsy



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What is Cerebral Palsy?

Cerebral = related to the brain

Palsy = loss or impairment of motor function

- cerebral palsy is **nonprogressive**
- cerebral palsy is **incurable**

Caused by damage to the brain:

- before birth
- during birth
- after birth (rare)

Half of all people with cerebral palsy were prematurely born.

Symptoms include:

- developmental delay in infants/toddlers
- lack of muscle coordination
- tremor or involuntary movement; difficulty with precise movement
- variations in muscle tone
- difficulty swallowing or speaking

Ways to diagnose:

Cranial ultrasound on premature infants, CT scan, MRI scan (the best)

Types of Cerebral Palsy

Four types:

- *spastic*: stiff muscles
- *dyskinetic/athetoid*: writhing movement
- *ataxic* (rare): poor balance/coordination
- *mixed* (common)

2/3 of children with cerebral palsy have the spastic type.

The spastic type has six subtypes.

Three different affected areas:

- *hemi*: half the body (left or right side)
- *di*: the legs
- *quadri*: the legs and the arms

Two types of severity:

- *paresis*: weakness
- *plegia*: paralysis

Area + Severity = Subtype
hemi + paresis = hemiparesis

Technological Aids

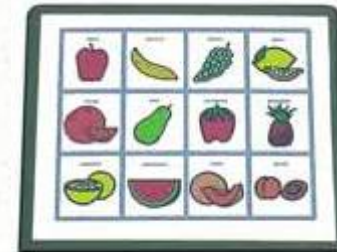
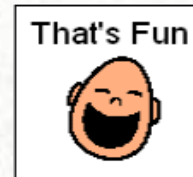
Examples of Assistive Technology (AT):

- electric wheelchairs
- leg braces
- switches
- hearing aids



Examples of Augmentative and Alternative Communication (AAC):

- Picture Communication Symbols (PCS)¹
- communication boards
- voice synthesizers



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Motivation

Many children with cerebral palsy have trouble using their hands to perform tasks so they often use switches. There are programs designed for switch access, usually for educational purposes.

Toys help a child's cognitive, social, and physical development², but children with cerebral palsy are often not able to play directly with them.

If a switch-accessible program could be used for other purposes, it would make the development of assistive devices much easier.

²A. Howard, "Introduction to Healthcare robotics," ARTSI presentation, Atlanta, May 2009.

Objective

To build a graphical user interface with the Boardmaker® Plus! software that could allow a child with cerebral palsy to command a robot to play a toy piano.



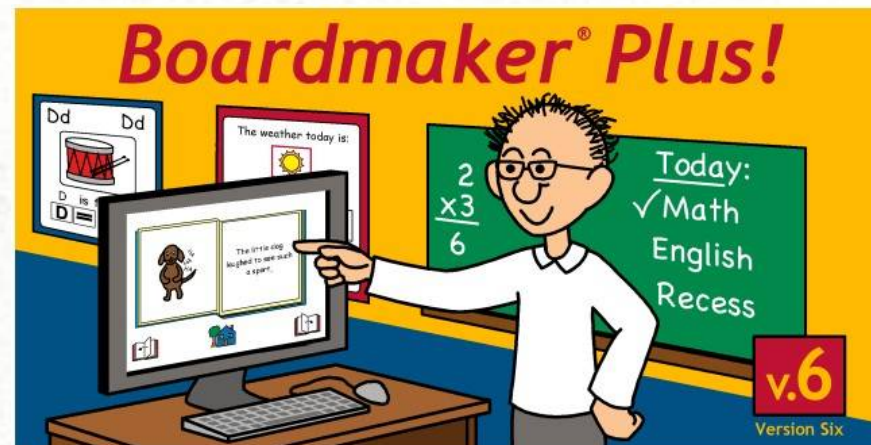
The Software

Boardmaker® Plus! is software for teachers.

- drag-n-drop/WYSIWYG approach
- AT features
- AAC features
- the buttons on a board can perform multiple actions when clicked

Other features:

- can customize buttons and boards
- can import images
- can create mini popup boards
- can play videos and sounds
- can use variables/conditionals
- can open external files
- can launch external applications



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Authorized User:

Version: 6.1.4



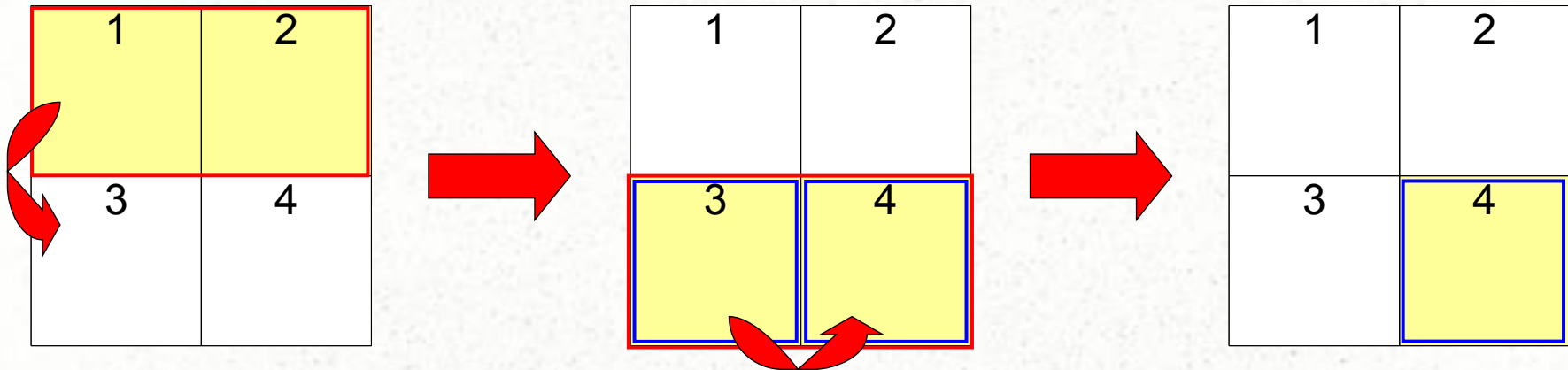
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Scanning

Switch users typically use Row/Column Scanning:

- developed in the 1970's
- the software highlights options first by row, then by column



Three types:

- auto-scan
- inverse scan
- step-scan

There is evidence that a user's type of cerebral palsy will determine how well they can use a scanning type.

The Switches

Two assistive switches were used for the project.



Jelly Beamer wireless switch with wired receiver.

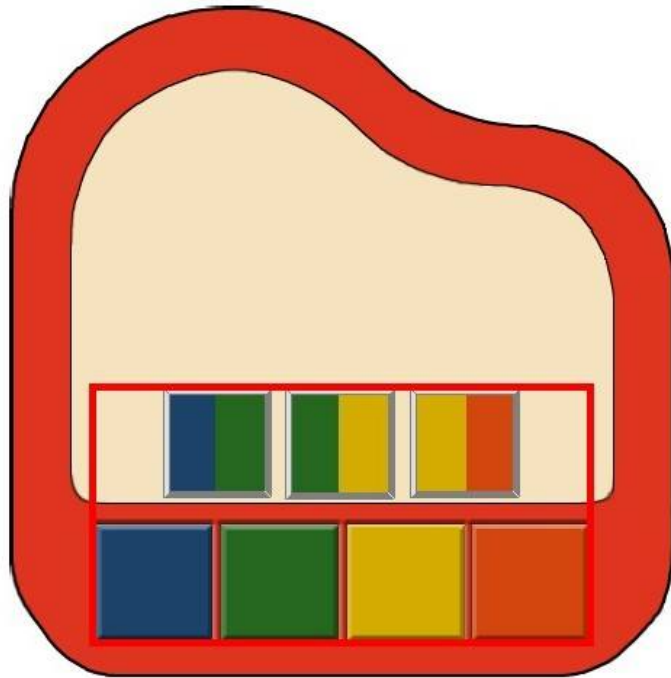


QuizWorks wired slammer switch.



QuizWorks USB switch interface.

Main Piano Board



Key scanning group highlighted:

- top buttons = double-key notes
- bottom buttons = single notes

Selecting the group will start the key scan.

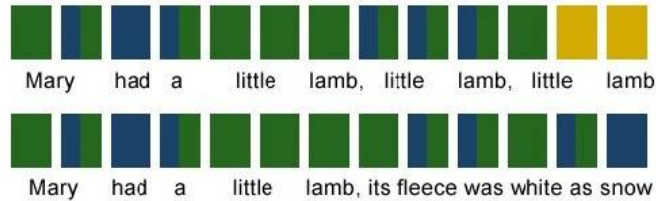
Selecting a key will command the robot to hit the corresponding key on the physical piano.

Play
Songs

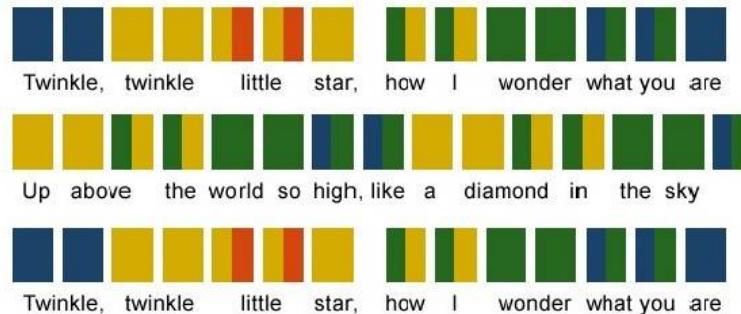
Quit
Program

Song Board 1

Mary Had a Little Lamb



Twinkle, Twinkle Little Star



The first song board with a highlighted song title. Pressing a switch at this moment will command the robot to play “Mary Had a Little Lamb”.

Song Board 2

Row, Row, Row Your Boat



Row, row, row your boat gently down the stream



Merrily, merrily, merrily, merrily life is but a dream

Naquasia's Song



The second song board with the navigation scanning group highlighted.

Complications

- Boardmaker and the RIOS software for the robot did not get along.
- Boardmaker must be installed and the CD must be in the drive to use a board.
- You cannot use a switch with a computer without a switch interface.
- The wireless switch did not work as expected.
- Row/Column Scanning prevents the user from selecting a previous button before the scan has looped.
- Auto-scan and inverse scan prevents the user from selecting a button more than once without waiting for the scan to loop.

Conclusions

- Boardmaker Plus! can help a user with cerebral palsy interact with external devices.
- Boardmaker Plus! can help a child with cerebral palsy go beyond his or her physical capability.

Future Work

- Software like Boardmaker could be used to give a switch-user access to software and devices that are not switch-accessible. This will prevent people from buying special versions of common software.
- Boardmaker could be used as a model to create adaptive software for the physically disabled.

Acknowledgements

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