Proposal
Team 22

Sensory Board for Adam’s Adventure Playground

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Executive Summary

The goal of this project is to develop a sensory board for Adam’s Adventure, a local playground in Tolland, CT designed so that all children are able to use it despite any disabilities that they may have. The Adam’s Adventure board of directors has asked us to build this sensory board, which is an interactive wall that will have activities and games built in to specifically entertain children with disabilities. The sensory board will need to be sustainable and cater to children with several different disabilities such as autism, mobility impairments, blindness, deafness, ADD, ADHD and more. Children with these disorders and disabilities have different needs that should be met on this sensory board. For example, children who may be blind or deaf will need a lot of sounds and colors, respectively.

This interactive wall will also need to be colorful, whimsical and fun for all the children, not to mention it will require minimal to no maintenance. We will be looking for materials that are weatherproof, child proof, vandalism proof and sealable to be able to contain electronic equipment without there being any damage. The main goal of this project is to create a safe, sustainable, reliable and fun piece of equipment for these children who have not been able to truly enjoy the full potential of other playgrounds.

1. Introduction

1.1 Background

Playgrounds are typically a place for children to relax, have fun and enjoy their youth. However, for children with special needs, this can be challenging. Disorders such as autism, mobility impairments, deafness, blindness and many others can greatly affect a child's quality of life by limiting their ability to interact with other children and the world around them. Children with autism, for example, may have overly sensitive senses, have trouble with proprioception and often require greater time to process information. Children with mobility impairments may have trouble gripping objects or reaching surfaces. Thus, these impairments can definitely make it difficult for children to access all parts of the playground and enjoy their time there.

Adam’s Adventure is a playground for special needs children of all ages, which was initially inspired by the story of Adam Mlodzinski. This 7-year-old boy loved his teachers, enjoyed playing with friends, had loving relationships with his sisters and his dog, and was a soccer star. However, what was originally thought to be a simple ear infection escalated until he had to be airlifted to Connecticut Children’s Medical Center. The ear infection had become Bacterial Meningitis, and he remained at the hospital in a coma for several months. After months of praying and hoping, he woke from the coma. However, he will never be quite the same as he was before as the illness left him without sight and with learning disabilities caused
by brain damage from the disease. Despite being blind and having to relearn basic skills, Adam has been able to resume his childhood and continues to bring joy to those around him. This inspiring young man has made a difference in so many lives that many residents in the town of Tolland have dedicated many hours of their free time to build a playground in Adam’s name to make all children, regardless of any disabilities that they might have, feel welcome.

1.2 Purpose

The mission statement of the Adam’s Adventure initiative states,

“We dream of building a playground where children of all abilities can play freely. A place where there are no limitations and where there is something for everyone. Adam’s Adventure will be designed to accommodate not only Mobility Impairments, but also Auditory Disabilities, Autism Spectrum Disorders, Cognitive Impairments, Visual Disabilities and more. Whether they wish to swing, to climb, to play music, or just need a quiet place to rest, the children will find it there. We dream of a place that will be….A Playground for EVERYONE!” [AdamsAdventure.org]

Thus, the purpose of this project is to build a sensory board for children of all abilities to be able to easily access and play with enjoyably. Since it is for all disabilities, it will be necessary to include sounds for the blind, colors and visuals for the deaf, activities for those with autism spectrum disorders, to be stationary for those with mobility issues and to be accessible for those in wheelchairs. The main objective is that these children will be able to have fun at the playground, and not feel limited by their disabilities.

1.3 Previous Work by Others

There has been no previous work done on this specific sensory board idea but there are other playgrounds that cater to children with disabilities. Many of these playgrounds have incorporated smaller sensory boards throughout the layout in an effort to incorporate a variety of different sensory experiences on each board. There are a large number of companies that presently make such panels to accommodate disabled children. The boards that have already been developed are in the form of individual sensory boards in which there is one focus per item. These boards have incorporated subjects such as music, braille and sign language, learning how to tell time, and more.

1.3.1 Products

In Connecticut alone, there are a number of playgrounds that have been developed to allow children with disabilities the opportunity to participate in playground activities. Most, if not all, of these playgrounds have at least one sensory board incorporated. In Milford, CT, Bodie’s Place is a “Boundless Playground” that was opened in spring of 2011. This playground incorporates numerous individual sensory boards throughout. Activities include a braille riddle
board, sign language board, plastic drum set, and more. Although the park has only been open for just over a year, it is apparent that these sensory boards were well damaged, affecting the quality of equipment available for the children that visit. In the riddle board, there is noticeable vandalism and scratches, revealing the answers to the riddles immediately by looking at the board. The rotating bead movement board has apparent water damage, most likely from weather, and already has noticeable failure of materials. It is important to take these failures into account when designing the Adam’s Adventure sensory board so that it does not continue this trend of faulty playground equipment.

During the visit to Bodie’s Playground, various children were questioned to see what their favorite sensory boards were before designing the Adam’s Adventure board. Their responses conveyed the general feeling that they were more likely to use a board that was geared toward a fun activity for them to participate in. Boards that simply displayed the braille alphabet or the sign language alphabet were not appealing to them and therefore were not used as frequently. The importance of designing boards that were attractive for children should be a guiding force for determining the contents of a playground sensory board.

In addition to Bodie’s Place, there are many other Boundless Playgrounds available for children within the state of Connecticut and throughout the United States. Each of these playgrounds seems to incorporate musical, educational, and inclusive components. Many of the boards incorporate braille, making it easier for visually impaired children to participate in the activities. Sound production also allows visually impaired children to be stimulated by a sense other than vision. The boards are made of bright, colorful materials, so that autistic and hearing impaired children are visually stimulated as well.

Landscape Structures Inc. is a company that produces a number of various sensory playground equipment designed for children with disabilities. Although the equipment they produce is not limited to purely sensory boards, they do have a large number of sensory boards available for purchase. These boards can be viewed on their website (www.playlsi.com). Many of these boards were the ones present at the Bodie’s Place playground.

2. Project Description

2.1 Objective

This project entails the creation of a sensory board for the playground, so that children with disabilities are able to enjoy a playground that was made specifically for them. This sensory board is necessary to stimulate the senses of those missing a sense and those with other disorders that may have inhibited their ability to enjoy a typical playground. A standard playground does not facilitate the needs of children with disabilities, making it difficult for them to enjoy their time there; thus, the purpose of this board will be to cater to their specific needs.
The sensory board will have braille, bright colors, sounds, and textures. The client has asked that these components be integrated into the board because this will ensure that every child from every background can enjoy it. The braille will be used everywhere (instructions on how to play a game, wherever there are letters, etc.) to ensure that just because a child is blind, doesn’t mean that they can’t have fun. Bright colors, sounds and textures will also be used on the sensory board to guarantee that the board will have a whimsical feel to it and that children of all backgrounds can enjoy.

This board will be going on a playground for children, and it is important that this is kept in mind when designing it so that it will not only be functional, but also look appropriate. The client has stressed that appearances are important for the sensory board since it will be in a public place for children, and not in a lab being used by engineers. It is important that the user of the board is constantly considered throughout the design and building process. This can be done by making areas where children in wheelchairs can roll up underneath the board and be able to reach any game they want to play with. There will also be several components which are large and easy to access for children who may have a disorder in which there are muscle spasms and may have limited fine motor skills. It should include some simple games that the children can play both individually and with others to make sure that children who may be more introverted or have social anxiety can enjoy the playground as much as the children who are more outgoing.

Since there is limited time to design and build the sensory board, it will be aimed to be simple and versatile. This is extremely important because not only will it be costly (both economically and time wise) to make the board more complex, it will also limit how many activities we can add to the sensory board. The simpler and more versatile the board is, the more games the children will be able to play and the more time the design team can spend making the board be a quality piece of equipment.

Electricity will be needed for many of the components on the sensory board. Initially, a solar panel was going to be used for energy, but this has been deemed too expensive and inefficient for the project. Fortunately, included in the playground is a concession stand and bathrooms. Hence, the electricity from these buildings will be connected using an inverter to the sensory board via wires underground.

Safety and resilience is also an issue that needs to be taken into consideration. Some of these children may have muscle spasms or even seizures, so it is imperative that the board is going to be safe and child proof in case something like this happens. The board will go under a lot of harassment from just the users alone, not to mention all kinds of weather conditions and attempted vandalism. One of the bigger concerns is that this board is aiming to last, ideally, a couple of decades without repair or replacement. This means that it will need to be durable and have components that cannot be easily broken. This is another reason why it is important that the board is simple -- the more complex it is, the more opportunities there will be for something to go wrong. Upon the finish this project there may not be anyone to maintain it if something goes wrong, so resilience and durability will be taken into account as well.
The main aspects of the board will be focused on are simplicity, versatility, fun, whimsicality and safety. This project should be an even balance of creativity, innovation and entertainment.

2.2 Methods

The sensory board will be 12 feet wide and about 4 feet tall, and just thick enough for electronic and other components to be enclosed inside. However, this board will need to be transported to the site in Tolland after it is built at the University of Connecticut Storrs Campus; thus, it will be built in three sections, each 4 feet wide, so that they can be transported without any special equipment and then assembled together on site.

This separation of the board into three smaller pieces allows for it to be created in parts. Since each 4 x 4 foot piece has a front and a back, the sensory board can be divided into a total of six panels. Each panel will have a different activity, or a particular theme. Some panels are more complex than others and some panels are for children of different ages or abilities. Each game and activity will also have a set of instructions in written language and in braille and most of the board will be powered by a solar panel that will have to be installed. The limited efficiency of the solar panel is taken into account when we designed our board. The panels are described in detail below.

Panel 1

The first panel on the sensory board will be geared to expose the children to a variety of musical components. The two different instruments included on this panel are chimes and a simulated piano. The chimes will rely on mechanical motion for the production of sound while the piano will use electronic components to produce sound and light. The chimes will produce sound by using swinging, hollow, metal cylinders. These cylinders will be of various lengths to produce different musical notes. Each cylinder will be suspended at the top and allowed to slightly swing, with the opposite end enclosed inside the board, limiting the motion of each cylinder. The movement of the swinging cylinder will cause the unsuspended end to come into contact with a metal portion on the internal side of the sensory board, creating a music sound. There will be eight different cylinders in the board, creating eight different notes and allowing children to play different songs.

The simulated piano will use push buttons in combination with internal electronic components. The buttons will be laid out on the board in the shape of piano keys, each key being approximately eight inches tall and three inches wide. There will be eight keys, covering the notes from low C to high C. Children will be able to play each key individually or press a separate button that will light up the keys to play one of three songs. The keys will illuminate using LEDs placed behind the plastic key buttons. The electrical power needed for this component of the board will be supplied by a solar panel.
In addition, the keys and chimes will also be labeled with the note that is produced by pressing the key button or hitting the chime. These notes will be depicted by both raised letters and braille letters to accommodate the needs of blind children. The LEDs present in the keys of the piano will allow hearing impaired children to play the depicted songs without hearing the sounds.

There is a music panel incorporated in this sensory board because music can be very therapeutic for children with various disabilities. Music has the ability to stimulate both the right and left sides of the brain simultaneously. It has also proven to encourage concentration in children with ADHD and improve sound perception in children with visual impairments. Music can also help children with any disability participate in artistic expression, while fostering creativity and fun.

Panel 2

The second panel will consist of a cognitive memory game. The memory game will be a series of lights that will randomly flash in a particular order and will be initiated by a child pressing a start button. Once the game begins one button will flash a color and the child will have to press the same button, and after doing so, the game will add another color/button to the sequence. This game will keep going until the child makes a mistake in the sequence, at which point the game will end and the child will have to press the start button to start over again. This game will require very little electrical power (since LED’s are extremely energy efficient) which can be stemmed from the solar panel that will be used to power most of our sensory board. Different colored LED lights behind a half spherical plastic casing can be used to both protect the LED’s from the environment and be used as the buttons. These buttons will be arranged in a pattern to grab the user’s attention.

This kind of game is great for children who suffer from deafness since it will have plenty of bright colors to stimulate their other senses. There has been research done that suggests that children with autism have a smaller neurological capacity for memory than other children. This game is meant to stimulate the hippocampus (shown to be underdeveloped in children with autism), which is the part of your limbic system that specializes in memory. This is important because the underdeveloped hippocampus in children with autism needs stimulation. This game will also be helpful for children with mobility impairments because the buttons will be big and easy to locate. Children with multiple sclerosis or cerebral palsy often have muscle spasms, so they have a limited range of dexterity and a lack of fine motor skills. This means that it is very difficult for them to grab small objects and focus their muscles to do specific tasks. The large buttons will cater to this need; by giving them a larger object to focus on, it will be easier for them to play this game without being reminded of their disability.

Panel 3
Panel three is intended mainly for visually impaired children. It will contain the entire alphabet in braille and have a few riddles (written in letters and braille) and the answer to each riddle will be in just braille. This will be a great exercise to get children who may be blind or visually impaired to interact with their surroundings and other children with helping them solve the riddles. It also may interest children with autism because they typically enjoy solving puzzles and riddles.

Panel 4

This will consist of several short-range sonar sensors to detect the movement of children in front of it, and LEDs to display the child’s movement. The sonar sensors work by emitting sound waves, which “bounce back” if something is detected. This is very similar in concept to a bat’s echolocation. The range of the sonar sensor should only be a few feet so that it does not pick up any noise from other children running by in the background.

![Diagram of sonar sensor](image)

LEDs will show through the panel so that lights trace the child’s movements. For instance, there can be one light lit up at each hand, each foot, each elbow and knee, the child’s head, and his or her mid-body.

The purpose of this is to get the children moving. They will enjoy seeing the light mimic their movements. It may even teach them to think about how their body moves. This panel will not include sound, so may not be optimal for blind children, but will be great for a deaf child as well as any others who love to move!

Panel 5

This panel involves a hand-crank, which has dual purposes: it will supply power to itself, and it will be a game. Because it is a hand-crank, if connected to the proper equipment, the mechanical work it takes to turn it can be converted into a usable form of energy: electricity. The electricity can then be used in the panel, and if there is enough energy generated by it, possibly even as a supplement to the solar panel in the other panels which require electrical energy. A hand-cranked generator, as in the figure below, could be bought and then incorporated into the panel and game if it is simpler than building it from scratch and is a reasonable price, shown below.
The game will have a gauge, or meter, for how much energy is currently stored in the
generator. This will be either a vertical gauge or a round gauge like one found on a car’s
dashboard, as pictured in the image below. The gauge will be made of LEDs. When a child
turns the crank, the gauge will fill up a bit. When they get past a certain point on the gauge (i.e.,
when it changes colors), there will be a sound effect and the lit part of the gauge may flash once.
If the child continues cranking, then the gauge will continue to fill up, and new sound effects
will occur at each level, until it is completely full. This is the point at which the generator can go
no higher. The child can then claim that he or she has “won” the game because they got to the
top.

**Figure 3 – Possible Crank for Panel 5**

![Possible Crank for Panel 5](image)

**Figure 4 – Possible gauge appearance for Panel 5**

![Possible gauge appearance for Panel 5](image)

**Panel 6**

This panel will be one in which children can use their creative sides and make a picture
of their choice. There will be a grid of squares on this panel, and children will be able to push in
whichever squares they wish to use to make a picture, and each pushed in square will be a certain
color of the children’s choice. They will be able to choose from the three primary colors, then
press in a square, then push another square or switch colors and push in a square. There will also be a “Reset” button in order for them to reset the board when they wish to start their picture over or let another child have a chance to create a picture. Hitting the reset button will set in motion a motor in order to push the squares back out again into their original starting position. This should be a fun and creative cognitive activity which most children will be able to use effectively.

3. Budget

Panel 1

For panel one, the chime set can be purchased from the Miracle Recreation Equipment Company (http://www.miracle-recreation.com/products/modular-playground-equipment/activity-panels/chime-panel.html). The piano keys will have to be ordered from a polymer manufacturer. The LEDs underneath the keys can be bought for a minimal cost of no more than $2 each, for a total LED cost of no more than $16. Speakers will also have to be purchased to produce the sounds from the piano keys. The total cost of this panel should be less than $150.

Panel 2

Panel 2 (which consists of the memory game) will be very cost effective. We will purchase LED’s that will be no more that $2 each. If we plan to have around 6-10 LED lights for the memory game, this should not surmount to more that $20. Another necessity is plastic covers for the LED lights, which will also be extremely cheap and will not cost more than $50 total for all of them. In total, the amount that this panel alone should cost will be around $100.

Panel 3

Panel 3 (braille alphabet and riddles) will have to be priced out by a manufacturer to find how we can put the engravings on the piece of equipment. This panel should not cost more than $150.

Panel 4

The sonar panel may be somewhat expensive, as it will require about five sonar sensors, depending on their range, to spread throughout the board. It will also need a microcontroller to process the information being input from the children to the sensors to send to the LEDs. Circuitry will be needed to tell which LEDs to light up, and then there will need to be lots of LEDs in total. MaxBotix sells sonar sensors for approximately $25 a piece, or five for $125. With this plus the other components, this panel will likely total around $250.
Panel 5

A hand crank is needed for this project. These can be found at various stores or online, typically for a price around $20 or higher. Another option is to use a hand crank generator, which can be bought for $21.95 from Teacher Source, and which generates up to 12 V of energy (http://www.teachersource.com/product/hand-cranked-generator/electricity-magnetism). This generator seems like it could be a very good option. It would then need to be connected to a gauge of some sort so that the children are able to visually see how much energy is being generated while they are turning the crank.

It may be possible to buy a gauge, such as a pressure gauge for a bike, for as little as $17.99 (http://www.volleyballcentral.net/pocket-pump-with-gauge.html), but this may not fulfill the requirements. First, it may be too small to see on a whole panel which people of different heights, sizes, and abilities must be able to see. Second, it is meant for pressure, and it is needed to measure the amount of energy being generated. Thus, it may be necessary to build an electrical gauge instead to serve the project’s purposes. If a simple bike gauge did prove to be sufficient, the panel would still need some circuitry to connect the filling of the gauge to the hand crank and generator.

Thus, the estimated price for this panel is under $100 after counting the hand crank and generator, the gauge, and any circuit elements required to connect the parts of the board.

Panel 6

This panel, with the Create-A-Picture activity, will likely cost about $250 because of all the components it requires. First, it will require lots of buttons of some type of material. It also requires multicolor LEDs, which are more expensive than normal LEDs, as well as a microcontroller. However, the most expensive part may be the motor required to push the buttons back out again to reset the game.

General

Electrical

The electricity going from the concession through the ground to the sensory board has the potential to be relatively expensive. For one, an inverter will be needed to convert between AC and DC currents. For another, a licensed electrician will be needed to connect our panel to the concession’s electricity through the ground, as there are engineering standards to adhere to and specialized training required for that process. If a volunteer electrician cannot be found, one may have to be hired.
Sensory Board Background

The actual panels of the sensory board must all be made using the same material, despite the different components. Overall, as explained earlier, there are three double-sided panels of 48x48” needed, minus the the parts which may get cut out in the middle for certain games in the panels (i.e., Tic Tac Toe). Thus, 4’x4’ pieces of high density polyethylene (HDPE) will be needed. A single 4’x8’ piece of HDPE costs over $400 alone. Since two or three of these will be needed, the total cost of the sensory board could be over $1200 after taxes and shipping costs. Rather than have this take up the majority of the budget, the HDPE vendors will be sent a letter asking them to donate the material or discount their price for the cause.
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<tr>
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<th>Cost</th>
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<tr>
<td>HDPE</td>
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<tr>
<td>4 Poles between panels</td>
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<td>Music Panel - Panel 1</td>
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<td>Microcontroller</td>
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<td>LEDs</td>
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<td>Chimes</td>
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<td>Microcontroller</td>
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<td>LEDs</td>
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<td>LED covers</td>
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<tr>
<td>Buttons</td>
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<td>Shipping &amp; Handling Expenses</td>
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<tr>
<td><strong>Total</strong></td>
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Table 1 – Summary of Project Budget
4. Conclusion

Adam is an amazing individual who, when confronted with an obstacle, faced it head on. His bravery and optimism has given so many the motivation and inspiration that started this project. The sensory board, although not a completely novel idea, is going to be custom designed and built based on the needs of the clientele. It will incorporate many factors to it, including lights, sounds, colors, interactive activities, and more to ensure that Adam’s Adventure will truly be a playground for everyone, including not only children with visual, auditory and mobility impairments, but also children with autism, ADD, ADHD and more. Appearance will be an important detail to consider because it will be in a public place and will need to catch the attention of the children who may be using the sensory board. It is necessary that this board be not only be functional, but that is entertains, is enjoyable and looks appropriate as well.

There are many aspects to consider in the design and building process for this project, such as sustainability, reliability, resilience, simplicity, versatility, safety, and overall cost of the materials. All of these concepts are important because they are imperative in making this board the most successful it can be for these children and the community.

In general, this project’s main goal is to improve the quality of life of the children of Tolland. Both them and their parents and caregivers have most likely struggled with their disabilities and it is important that they will have a place to enjoy themselves and forget about their disorders and disabilities. This project has touched very many people personally through directly knowing Adam himself, or being able to relate to the situation in some way. Since this sensory board will be put to use at the end of the school year for a noble cause that could really change the lives of some children, this team has taken a personal interest in making this sensory board the best that it can be.

References

- http://www.autismtreatmenttrust.org/?p=2048
- http://serendip.brynmawr.edu/exchange/node/2040
- http://www.walmart.com/ip/8221490?adid=2222222227010204590&wmlspartner=wlpaw0=&wl1=g&wl2=&wl3=13683681430&wl4=&wl5=pla&veh=sem
• www.playlsi.com
• http://www.ibm.com/developerworks/web/library/wa-svgbitmap/