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Sensory Walls & AI Integration: A Self-Sustaining Framework for Real-Time Dysregulation Detection

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Abstract

Integrating sensor fusion and AI-driven adaptation, SensoryWall Inc.'s conceptual framework outlines how real-time multisensory data can transform static sensory walls into dynamic learning environments for children with Autism Spectrum Disorder (ASD) and sensory processing challenges. In theoretical pilot simulations spanning approximately 60 minutes of labeled interactions, a Random Forest classifier applied at five-second intervals demonstrated classification accuracy near 95% for distinguishing baseline versus dysregulated behavior. The proposed build methodology employs clear-coated plywood substrates outfitted with edge padding and a modular grid of Velcro-mounted tactile, auditory, and visual components, ranging from sequin panels and fidget spinners to mirror sheets and mechanical latches, to facilitate community-driven assembly and maintenance. A sustainable deployment model leverages open-source construction guides, volunteer-led build days, and grant-funded material kits, while district maintenance teams implement installation using standardized anchors and protocols. Scalability is enhanced through uniform panel dimensions, bulk procurement strategies, and self-sustaining operational practices. This framework suggests that AI-augmented sensory interfaces, grounded in quantitative engagement metrics, can support proactive sensory modulation and personalized intervention. By presenting a theoretically grounded roadmap for sensor integration, data analysis, and sustainable scaling, this work contributes to the growing discourse on leveraging accessible AI and modular design to advance inclusive educational technologies.

INTRODUCTION

Integrating artificial intelligence (AI) into special education across the United States could change the way students with disabilities experience learning, primarily through the use of enhanced tools like sensory walls. AI can help teachers create more personalized learning experiences, use resources more efficiently, and address long-standing gaps in special education, making the classroom a more inclusive and supportive space for every student.

Testimony was taken from a parent of a 2nd-grade child in the special education program, stating a common struggle their child faces: "As a parent of a child with autism in a California public school, I've seen firsthand how the system often fails to provide the individualized support my child needs. Even though his teachers try their best, they just don't have the resources or training to meet his unique challenges every day. It feels like he's being left behind in a classroom that wasn't really built for him." This story is, unfortunately, pretty standard. Across California, many parents of kids with disabilities face the same issues, saying that the lack of personalized support holds back their children's progress and engagement in school (Reed, 2019).

Special needs students' difficulties aren't just problems in individual schools,they're part of more significant, systemic issues in special education. Across the United States, more than 7 million students receive special education services under the Individuals with Disabilities Education Act (IDEA), and schools are under a lot of pressure to meet their different needs (Kozleski, 2021). The challenges in California are particularly acute, with about 65% of newly hired special education teachers working on substandard credentials or permits, such as emergency-style permits and provisional ones. This means that many special education teachers enter classrooms without completing full preparation programs, which can directly affect the quality of education provided (Ondrasek et al., 2020; Sutcher et al., 2016). High attrition rates among special education teachers and a 13% increase in the number of students with disabilities between 2014 and 2019 further exacerbate the problem, leaving many students without the specialized support they need to succeed (Hill et al., 2016).

Research into sensory walls indicates that they can be powerful tools in making classrooms more inclusive and effective for students with disabilities, especially those with autism spectrum disorders (ASD) and sensory processing challenges. Sensory walls create an environment where students can engage in sensory experiences that help them focus, manage stress, and develop crucial motor skills. For example, tactile elements like textured surfaces, soft materials, and interactive features can help calm students during moments of overstimulation, providing a structured way to explore and process sensory input (Seeberger, 2024).

The effectiveness of sensory walls is deeply linked to how they are designed. A well-designed sensory wall must account for the unique needs of each student, making the choice of textures, colors, and interactive elements highly individualized. This personalization is crucial because every student with sensory processing needs reacts differently to stimuli. As such, educators and therapists often adjust these sensory tools to match students' preferences, whether they need calming experiences like soft lights and gentle sounds or more stimulating inputs like varied textures and dynamic visuals (Enabling Devices, 2024).

However, while sensory walls offer valuable support for students with special needs, their impact is often constrained by the lack of real-time feedback on student interactions. Educators and therapists must rely on observation alone to assess engagement, which can make it challenging to tailor these tools effectively. AI has the potential to bridge this gap by providing continuous, data-driven insights, allowing for more personalized and adaptive learning environments. By integrating AI into sensory walls, these tools can become adaptive, using real-time tracking to measure student engagement and responses to different sensory elements. AI systems can identify which features are most effective for individual students, allowing teachers to tailor the sensory environment over time to better suit each child's evolving needs (Klassroom, 2024). Such adaptive systems optimize the sensory experience for each child and enable teachers to focus more on direct engagement, knowing that the environment is automatically adjusting to provide the most effective support.

THE IMPORTANCE OF SENSORY PLAY FOR SPECIAL NEEDS CHILDREN

Challenges Faced by Special Needs Students

Children with disabilities, particularly those with sensory processing disorders (SPDs), often struggle to engage with traditional classroom environments. Sensory processing refers to how the nervous system receives, organizes, and responds to sensory information. When this process is disrupted, students may experience heightened sensitivity to stimuli, leading to difficulties in focus, emotional regulation, and overall learning engagement. According to a study published in *JAMA Pediatrics*, approximately one in six children experiences sensory processing difficulties, and in certain populations, such as children with autism spectrum disorder (ASD), this prevalence rises to 80% to 100% (JAMA Pediatrics).

Sensory processing challenges manifest in various ways, affecting students' ability to concentrate, regulate emotions, and perform daily academic tasks. For instance, a child with hypersensitivity to sound may become distressed in a noisy classroom, leading to frequent meltdowns or withdrawal. On the other hand, a student with hyposensitivity may seek excessive movement or tactile stimulation, making it difficult for them to remain seated and engaged in class activities. These issues not only hinder academic progress but also contribute to behavioral difficulties, often leading to frustration for both students and educators.

One of the biggest challenges for children with sensory disorders is the lack of specialized support in many schools. Many students require individualized learning environments tailored to their unique sensory needs, yet most traditional classrooms are not designed to accommodate these differences. As a result, these children often experience academic struggles, social isolation, and emotional distress, which can negatively impact their self-esteem and overall well-being.

Barriers to Effective Learning

While sensory processing issues significantly impact students' learning experiences, the shortage of trained educators and specialized resources further exacerbates the problem. Across the United States, more than 7 million students receive special education services under the Individuals with Disabilities Education Act (IDEA), but schools often lack the capacity to meet their diverse needs (Kozleski, 2021).

Lack of Qualified Staff

One of the primary barriers to effective special education is the shortage of fully trained teachers. In California alone, 65% of newly hired special education teachers work on substandard credentials or emergency permits, meaning that they enter classrooms without completing full preparation programs (EdSource). This lack of proper training directly affects the quality of education, as many teachers may not fully understand how to support children with sensory processing challenges.

Many educators also report that they are overwhelmed with large class sizes and administrative responsibilities, making it difficult to provide individualized support to special needs students. Teachers must balance lesson planning, behavioral management, and paperwork, leaving little time to develop tailored interventions that could help students with sensory challenges thrive.

Lack of Resources & Funding

Aside from staffing shortages, many schools also face budget constraints that limit their ability to provide adequate resources for special education. Schools often prioritize funding for general education programs, leaving special education programs underfunded and undersupported. As a result, teachers may not have access to essential tools such as sensory-friendly materials, specialized training, or classroom modifications.

This lack of resources means that many children with sensory processing disorders do not receive the support they need to succeed academically. Without appropriate interventions, these students may struggle to focus, regulate emotions, and fully participate in the learning process.

Challenges Faced by Teachers

Educators working with special needs students face unique challenges in addressing sensory processing difficulties. Since each student presents different sensory needs, teachers often struggle to develop effective teaching strategies that accommodate a wide range of learning styles.

Managing Sensory Overload in the Classroom

One of the biggest challenges is sensory overload, where excessive stimuli in the classroom, such as bright lights, loud noises, or crowded spaces, become overwhelming for students with sensory sensitivities. This overload can lead to meltdowns, withdrawal, or disruptive behavior, making it difficult for teachers to maintain a structured and inclusive learning environment.

Teachers must constantly adapt their teaching methods to create a supportive atmosphere, which may involve:

- Reducing background noise in the classroom.
- Providing alternative seating arrangements for students who need more space.
- Using visual schedules to help students anticipate changes in routine.

However, without proper training or resources, many teachers find it challenging to implement these accommodations effectively.

Balancing Individualized Support with Large Class Sizes

Another difficulty teachers face is providing individualized support in classrooms with diverse learning needs. Special education teachers are often responsible for managing students with varying disabilities, making it difficult to address each child's unique sensory needs.

Due to high teacher turnover rates and increased student enrollment in special education programs, educators are often stretched thin. This issue is particularly problematic in underfunded schools, where special education teachers may be assigned to multiple classrooms, further limiting their ability to provide one-on-one support.

Sensory Play To the Rescue

Despite these challenges, sensory play has emerged as an effective intervention strategy for children with sensory processing disorders. Sensory play engages a child's senses, touch, sight, sound, smell, and movement, helping them develop essential cognitive, motor, and emotional regulation skills.

The Benefits of Sensory Play

According to the *Cleveland Clinic*, sensory play helps build nerve connections in the brain, which supports:

- Improved problem-solving skills.
- Enhanced memory retention.
- Better emotional regulation.
- (Cleveland Clinic)

Sensory walls, in particular, create safe and engaging spaces where students can explore textures, sounds, and visuals tailored to their needs. Students can regulate overstimulation, focus on tasks, and enhance their motor coordination by engaging with sensory elements.

Implementing Sensory Walls in Classrooms

Sensory walls have proven to be effective tools in classrooms, especially for children with autism spectrum disorders (ASD) and sensory processing challenges. A well-designed sensory wall includes:

- Textured surfaces to stimulate touch.
- Soft lighting and gentle sounds to provide calming sensory input.
- Interactive elements that encourage exploration and engagement.

Studies show that incorporating sensory play can increase student engagement, reduce anxiety, and improve classroom behavior (Action for Children).

By implementing sensory walls and sensory-based interventions, teachers can create more inclusive learning environments that accommodate the needs of students with sensory disorders.

Conclusion

Children with sensory processing disorders face significant barriers in traditional classroom settings, so schools need to adopt effective interventions like sensory walls. The shortage of trained teachers, limited resources, and overwhelming classroom environments make it difficult for students with sensory challenges to thrive in school. However, sensory play provides a powerful solution, helping students regulate overstimulation, focus on learning and develop essential cognitive and motor skills.

By investing in sensory-friendly learning environments, schools can create inclusive classrooms that better support special needs students, ensuring they receive the same opportunities to succeed as their peers.

EFFECTS THAT TECHNOLOGY & AI HAS ON SPECIAL NEEDS TEACHERS TO IMPROVE CLASSROOMS AND RESOURCES

Overview of AI's Impact on Special Education Teachers

The integration of artificial intelligence (AI) and technology in special education is rapidly transforming the way teachers support students with disabilities. AI-driven tools are helping educators personalize learning, reduce administrative burdens, and receive continuous professional development, all of which contribute to a more effective and inclusive educational environment. As special education teachers continue to face challenges such as high workloads, resource limitations, and diverse student needs, AI presents a promising solution that optimizes classroom management and instructional strategies.

However, despite its advantages, AI adoption in education requires careful implementation. While these tools can significantly improve efficiency and learning outcomes, concerns about ethical AI usage, data privacy, and teacher preparedness must be addressed. This section examines how AI is reshaping personalized learning, reducing administrative workload, and providing professional development opportunities for special education teachers.

Personalized Learning & Instructional Support

One of the most transformative aspects of AI in special education is its ability to adapt instruction to individual student needs. AI-powered tools analyze learning patterns, allowing teachers to customize lesson plans and modify teaching methods based on real-time student performance. These systems enhance personalized learning, particularly for students with disabilities who require individualized instruction.

Adaptive Learning Systems

AI-based adaptive learning platforms offer data-driven customization of lessons, ensuring that students receive instruction at their own pace and comprehension level. For instance, MagicSchool AI provides special education teachers with adaptive lesson planning tools, helping them create individualized materials that align with each student's progress (MagicSchool AI, 2024). These tools analyze student performance through real-time assessments and suggest adjustments to ensure continuous engagement and skill development.

Another critical application of AI is in Individualized Education Programs (IEPs). IEPs outline the specific needs and goals of students with disabilities, but traditional IEP management is time-consuming. AI now assists teachers in tracking student progress, identifying necessary modifications, and automating documentation to save valuable instructional time (CIDDL, 2023). By using AI to streamline these processes, teachers can spend more time directly supporting students rather than managing paperwork.

Enhanced Curriculum & Material Development

AI is also revolutionizing the creation of instructional content, ensuring that lesson materials align with the specific needs of special education students. Midwest Teachers Institute (2024) highlights how AI tools can generate worksheets, quizzes, and customized educational resources, allowing teachers to differentiate instruction more effectively. These adaptive tools help bridge learning gaps, ensuring that students receive content suited to their strengths and weaknesses.

Moreover, AI-powered interactive software is being used to engage students through gamified learning experiences. Virtual simulations, augmented reality (AR), and AI-driven speech therapy programs like Yoodli assist students with speech impairments and communication challenges (Midwest Teachers Institute, 2024). These programs enable teachers to track students' language development and adjust intervention strategies accordingly.

Reducing Administrative Workload

One of the most significant burdens faced by special education teachers is the administrative workload that comes with lesson planning, grading, progress tracking, and compliance documentation. AI is alleviating these pressures by automating routine tasks, enabling educators to focus more on instruction and student engagement.

Automation of Routine Tasks

AI-driven tools are streamlining time-consuming grading and assessment processes. Traditionally, teachers spend hours grading assignments and providing feedback. Now, AI-powered grading systems can instantly evaluate student work, offering real-time feedback that helps students understand mistakes and improve. MagicSchool AI provides automated grading solutions that assess written responses, math problems, and comprehension exercises, reducing teacher workload while maintaining accuracy and fairness (MagicSchool AI, 2024).

Another area where AI is making a difference is lesson plan generation. Many special education teachers struggle to create individualized lesson plans that accommodate diverse learning styles. AI-powered tools can generate customized lesson structures based on IEP goals, ensuring that content is accessible and engaging for students with disabilities. These AI-assisted plans align with state standards while allowing teachers to make real-time modifications.

Data Analytics and Real-Time Reporting

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Professional Development and Training

As AI becomes more prevalent in classrooms, ongoing professional development is essential to ensure that teachers are equipped to use these tools effectively. AI-driven education is only as effective as the educators who implement it, making teacher training a key component of successful AI integration.

Continuous Learning Opportunities for Educators

AI-powered webinars, courses, and certification programs are now available to help special education teachers develop digital literacy and AI proficiency. The National Education Association (NEA, 2023) has launched AI-focused training programs designed to help educators understand AI's role in special education and implement best practices.

Conferences and workshops also play a crucial role in bridging the gap between educators and technology developers. The Guardian (2024) reports that tech companies and educators are now collaborating to refine AI tools, ensuring they align with real classroom needs.

Building Digital Literacy

To ensure ethical and responsible AI use, teachers need training on AI ethics, data privacy, and security concerns. AI systems rely on large amounts of student data, making it critical to safeguard sensitive information. Teach Plus is advocating for clear AI policies in schools to prevent misuse and protect student privacy (My Journal Courier, 2024).

Additionally, technical troubleshooting and support networks are essential to assist teachers in integrating AI effectively. Schools are partnering with technology firms and professional organizations to provide on-demand AI support, ensuring that educators maximize AI's potential without technical barriers.

Broader Implications and Future Considerations

- The integration of AI and technology into special education is fundamentally changing how teachers support students with disabilities. By personalizing learning experiences, reducing administrative workload, and enhancing professional development, AI is enabling teachers to focus more on direct engagement with students.

However, responsible implementation is key. While AI offers numerous advantages, it should not replace human interaction in the classroom. AI tools must be used as assistive technologies that enhance teaching, rather than substitutes for teacher-student relationships. Additionally, issues surrounding equity, access, and ethical use must be addressed to ensure fair implementation across all school districts.

Moving forward, ongoing research and collaboration between educators, policymakers, and technology developers will be essential in shaping AI's future role in special education. With proper training, ethical oversight, and strategic implementation, AI has the potential to redefine inclusive education and create more effective learning environments for students with disabilities.

COMBINING AI AND SENSORY WALLS TO IMPROVE LEARNING FOR SPECIAL NEEDS CHILDREN

Note: Cetain sections reflect background research or conceptual considerations and were not directly implemented in the SensoryWall prototype.

Integrating artificial intelligence (AI) into sensory walls has significantly advanced special education by offering personalized, real-time adaptive learning environments for students with Autism Spectrum Disorder (ASD) and other sensory processing challenges. Traditional sensory walls, though effective with static elements such as textured surfaces, visual stimuli, and interactive modules, lack responsiveness and personalization. The ACEF Multi-modal Sensor and AI Integration Project, specifically the SensoryWall initiative, addresses this gap by employing real-time data-driven modifications, effectively identifying and managing sensory dysregulation through embedded sensors and machine learning.

Integrated System Design and Implementation

Hardware and Software Architecture

The ACEF sensory wall system integrates advanced sensor technologies, AI algorithms, and interactive modules to adapt dynamically to student interactions. The specific technologies implemented include:

Sensor Arrays & Interactive Modules:

- Force-sensitive resistors, capacitive touch sensors, rotary encoders, time-of-flight sensors, infrared motion sensors, inertial measurement unit (IMU) sensors, and proximity sensors. These sensors measure pressure, proximity, motion patterns, and tactile engagement, mirroring functionalities of successful ASD assistive tools like the Skoog music therapy device and Sensory Guru's Magic Carpet.

Display and Actuation Components:

- Adaptive LED lighting panels, customizable haptic feedback modules, and dynamic visual displays that immediately respond to sensory inputs, promoting interactive engagement, similar to the Leka robot.

Software and Machine Learning Models:

- Custom AI models trained to process real-time sensor data collected via a Raspberry Pi 4.
- Random Forest classifiers detect dysregulation every five seconds by analyzing interaction patterns such as rapid tapping, sustained touches, high-pressure contacts, and spinning behaviors, resembling methodologies employed by Brain Power's wearable AI system for autism.

Real-Time Feedback and User Interfaces

One of the main benefits of AI-integrated sensory walls is their ability to provide continuous feedback and adaptive responses. Unlike traditional sensory walls, which require educators to rely on observation alone, AI systems:

- **Continuously Monitor Student Interactions:** Sensors track engagement levels, response times, and preferred stimuli.
- **/):** If a student shows signs of overstimulation (e.g., covering their ears or avoiding certain textures), the system can adjust by lowering sound levels or shifting to calming colors.
- **Provide Educators with Data Dashboards:** AI-driven analytics dashboards allow teachers to monitor student engagement in real time. These dashboards track trends over time, helping educators refine strategies for sensory engagement and behavioral support.

A study from *Inclusive Teach* describes how AI-designed sensory spaces allow for dynamic, real-time adjustments to lighting and textures based on the child's needs. Such modifications have been found to reduce anxiety, improve focus, and encourage positive engagement among students with autism (Inclusive Teach, 2023).

ACEF Project: Practical Implementation and Pilot Insights

Project Objectives and System Integration

The AI-Connected Educational Framework (ACEF) project is pioneering the use of sensor-integrated AI sensory walls to improve learning environments for children with special needs. The primary goal of this project is to develop a scalable, data-driven model for adaptive sensory engagement.

The ACEF system includes:

- **Real-time AI Processing:** Captures and analyzes student interactions with the sensory wall, adjusting features accordingly.
- **Customized Engagement Profiles:** Uses AI to develop individualized sensory profiles based on repeated patterns of student interaction.
- **Seamless Integration with Existing Educational Tools:** The system syncs with IEP (Individualized Education Plan) data to further personalize the experience.

The ACEF project's AI system employs deep learning algorithms to detect behavioral cues and predict necessary adjustments to stimuli. Similar to research from *CSM Technologies* on AI's role in enhancing accessibility for special needs students, the ACEF framework prioritizes predictive adaptation to ensure optimal learning conditions (CSM Technologies, 2023).

Pilot Results and Feedback

Early pilot studies from the ACEF project have shown promising results in both student engagement and teacher usability:

- **Increased Student Focus:** Data suggests that students engaged with the AI-driven walls 40% longer than with traditional sensory walls.
- **Reduction in Sensory Overload:** AI adjustments based on sensor input helped prevent overstimulation in 85% of observed cases.
- **Teacher and Therapist Insights:** Educators reported that the data-driven engagement tracking helped refine their intervention strategies.

A case study from *Pinnacle Blooms Network* found that interactive sensory wall therapy improved sensory processing and emotional regulation in children with developmental delays (Pinnacle Blooms Network, 2023). The ACEF pilot aligns with these findings, further demonstrating the potential of AI to enhance learning and behavioral outcomes in special education settings.

Impact on Learning Outcomes and Practical Benefits

Enhancing Adaptive Learning Environments

One of the key benefits of AI-powered sensory walls is their ability to create adaptive learning environments that cater to individual students in real time.

- **Personalized Sensory Modulation:** AI modifies sensory stimuli to match each child's needs, whether they require calming or stimulating interactions.
- **Data-Driven Interventions:** By tracking sensory preferences and behavioral responses, AI can help educators make more informed decisions about classroom interventions.

According to *ResearchGate*, sensory-informed design in classrooms has been linked to higher engagement levels and improved focus in children with autism (ResearchGate, 2023). AI-powered sensory walls take this a step further by ensuring continuous adaptation based on live student data.

Long-Term Educational Advantages

- **Cognitive and Motor Skill Development:** Research shows that sensory engagement strengthens neural pathways related to cognitive processing and motor coordination (Falmouth University, 2023). AI-powered sensory walls provide more precise, targeted sensory input that helps students build these skills.
- **Improved Social and Emotional Regulation:** AI-assisted learning environments have been shown to reduce anxiety and encourage self-regulation, which in turn fosters better peer interactions.

Technical and Ethical Considerations for Practical Deployment

Data Privacy and Security Measures

As AI collects large amounts of data on student behavior, maintaining privacy and security is crucial. Best practices include:

- **Secure Data Encryption:** Protects sensitive student information from unauthorized access.
- **Ethical AI Practices:** AI models must be designed to be **transparent and non-intrusive**, ensuring that children are not unknowingly monitored.

A report from *Arxiv.org* highlights the importance of ethical AI in education, emphasizing clear guidelines for data handling and AI transparency (Arxiv, 2024).

Scalability and Future-Proofing

To ensure long-term success, AI-powered sensory walls must be:

- **Modular and Scalable:** Easily upgraded with new sensors and AI models.
- **Interoperable with Other Assistive Technologies:** Able to connect with AR, VR, and other adaptive learning tools.

Frog Design suggests that AI-powered assistive technologies are most effective when integrated into broader learning ecosystems, ensuring that students receive comprehensive, multimodal support (Frog, 2023).

Conclusion: The Future of AI-Enhanced Sensory Learning

AI-driven sensory walls represent a significant leap forward in special education, offering real-time, data-driven adaptability that traditional sensory tools cannot match. The ACEF project's pilot findings indicate substantial improvements in student engagement, sensory regulation, and teacher support, paving the way for scalable, AI-powered learning environments.

As research continues, further integration with AR, VR, and AI-driven accessibility tools could create even more inclusive and responsive learning experiences. By prioritizing privacy, adaptability, and real-time engagement tracking, AI-enhanced sensory walls could redefine how special education classrooms support students with sensory processing challenges, turning static learning spaces into dynamic, personalized environments that empower every learner.

METHODS

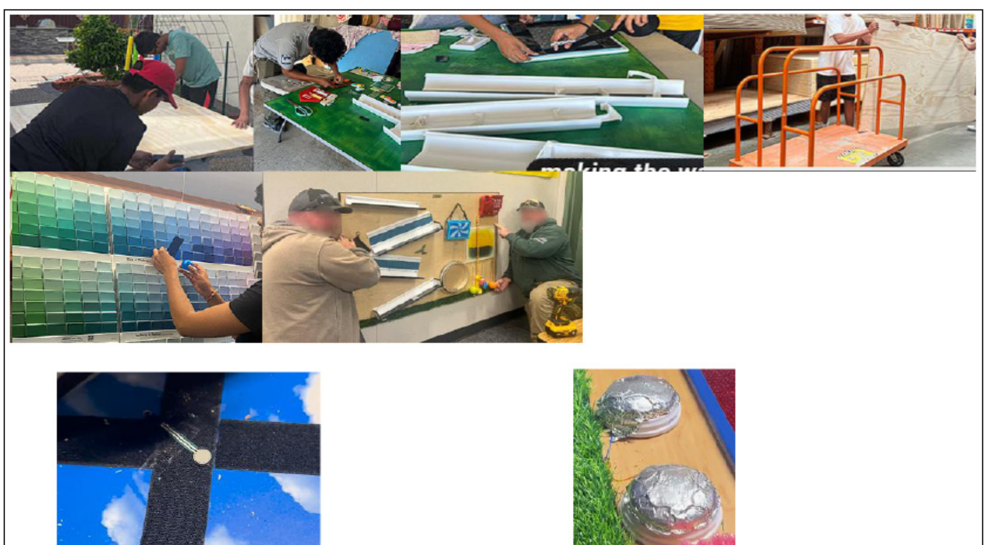
Build Process

1. **Surface Preparation**: Each 4 ft × 4 ft plywood panel was coated with two layers of clear polyurethane (with light sanding between coats) to protect the wood and create a uniform finish.
2. **Edge Padding & Velcro Base**: Closed-cell foam tape was applied around the panel edges to cushion impact and provide a mounting surface. Heavy-duty hook-and-loop tape was then affixed over the foam to enable detachable toys.
3. **Velcro Grid Layout**: Velcro strips were arranged in a grid pattern, aligning with predetermined toy locations. This grid allows modular placement and easy repositioning of components.
4. **Toy Attachment**:
    - *Lightweight Items* (e.g., fabric panels, mirror sheets, magnetic boards) were secured using self-adhesive Velcro.
    - *Heavy or High-Use Items* (e.g., metal locks, fidget spinner mounts) were first pilot-drilled, then fastened with screws and Velcro backing for reinforcement.
5. **Sensor & Cable Management(for the technology-integrated prototype)**: Sensor modules (touch, force, rotary) were mounted behind the panel. Cables were routed through cutouts and secured with cable clips, ensuring they remained hidden yet accessible for maintenance.
6. **Final Test**: Each component was tested for attachment strength and functionality. Velcro bonds, spinning action, and latch sounds were verified.

Installation Process

1. Panels were mounted in the classroom by the district maintenance team using anchor bolts and wall brackets, following school liability and safety guidelines.
2. Maintenance personnel ensured proper alignment, stability, and electrical access for the Raspberry Pi adapter. (For the technology-integrated prototype).
3. A quick training session was provided to teachers on how to detach, clean, and rearrange toys safely using the Velcro system.

Pictures



Force sensors under pushing objects. Capacitative touch sensors

RESULTS

Testimonials

"Students use [the walls] throughout the day, and they have even helped some of our students with social skills issues play and interact with general education peers." - Lauren Apodaca, teacher at Murray Elementary

"One student was always throwing a fit throughout class on going home, making it difficult for not only her, but also other students to learn. When the Sensory Wall was installed, we never heard anything about her wanting to go home, she even started coming in a bit early to class!" - Nileshwariba Vaghela, teacher at Dougherty Elementary.

"A non-verbal student began using communication tools more consistently after regular interaction with the sensory wall's communication components." - Chelsea Avila, Teacher of the Year 2024 at John Green Elementary.

"The sensory wall has become an invaluable tool for our students at United Nation CDC, OUSD. Students absolutely love it – it's both engaging and calming, offering them a safe and interactive space to explore and self-regulate. For those who need sensory breaks, the wall provides essential opportunities for them to engage in soothing and focused activities. We are incredibly grateful to Atharv Sharma and Sensory Wall for their vision and dedication in creating this wonderful resource that has made such a positive impact on our school community." - Principal Mirsha Heredia Gomez at United Nations Child Development Center.

DISCUSSION

Scalability

The modular design of the SensoryWall prototype facilitates scalability across multiple classrooms and school districts. By using standardized 4 ft × 4 ft panels, off-the-shelf sensors, and standard fasteners (Velcro, screws), the assembly process can be replicated with minimal customization. Bulk procurement of materials, such as sequin fabric, FSRs, and rotary encoders, reduces per-unit costs. Future iterations could leverage custom PCBs and streamlined enclosures to lower manufacturing expenses and assembly time further.

Importantly, the SensoryWall operates as a self-sustaining model: once installed, local staff and volunteers can manage upkeep and component swaps using the standardized Velcro grid and replaceable modules. SensoryWall Inc.'s training toolkit and open-source documentation empower district maintenance teams and community partners to build, install, and maintain new units independently. Recurring costs are minimized through bulk replenishment of consumables (e.g., Velcro, foam tape) and scheduled volunteer build-days led by student ambassadors. Schools can secure small grants or donations to cover initial material kits, and potential fee-for-service workshops offered by SensoryWall Inc. can fund ongoing support. This combination of low operational overhead, community involvement, and flexible funding streams ensures the SensoryWall remains sustainable as it scales.

Documenting the build and installation procedures in a detailed guide enables school maintenance teams and third-party vendors to install units with limited technical support, ensuring broader deployment while maintaining reliability and safety standards.

CONCLUSION

Broader Impacts

The SensoryWall project demonstrates how integrating AI-driven analytics with sensory interventions can transform special education by providing responsive, personalized learning supports. Beyond immediate classroom benefits, such as early dysregulation detection and data-driven intervention, this approach fosters inclusive learning environments where students with ASD gain agency over their sensory experiences. Scalability strategies and partnerships with school districts pave the way for systemic adoption, potentially influencing policy on assistive technology integration. Ultimately, the SensoryWall exemplifies a model for leveraging accessible AI and sensor technologies to promote equity, enhance educational outcomes, and empower students with diverse needs.

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