

---

# 'TellMe': Therapeutic Clothing for Children with Autism Spectrum Disorder (ASD) in Daily Life

## Helen Koo

University of California at Davis  
One Shields Avenue  
Davis, CA 95616  
helen.sm.koo@gmail.com

## Abstract

Special education and treatment methods in the early ages are the keys to relieving Autism Spectrum Disorder (ASD) symptoms. These smart clothing items 'TellMe' are designed to treat ASD symptoms in boys by encouraging them to speak out and express themselves while playing with and enjoying the clothing. Therapeutic functions, including different types of sensors (a flexible film-like pressure sensor, a light sensor, and a motion sensor) and actuators (LEDs, a DC motor, and a vibration motor), are incorporated to

Permission to make digital or hard copies of part or all of this work for personal classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other used contact the Owner/Author.  
Copyright is held by the authors.  
ISWC'14 Adjunct, September 13 - 17, 2014, Seattle, WA, USA  
ACM 978-1-4503-3048-0/14/09.  
<http://dx.doi.org/10.1145/2641248.2641278>

the clothing. By playing with the interactive robot characters on the clothing, such as speaking into the microphone or activating the sensors and other actuators, a child wearing the garment can naturally learn and practice how to express his feelings, emotions, and opinions.

## Author Keywords

Smart clothing; design; autism; children; treatment

## Concept

The number of children on Autism Spectrum Disorder (ASD) keeps increasing and has become a serious problem [1]. About 1 in 68 children has been diagnosed as ASD [2]. Children with ASD can be treated and relieved through the efforts of parents' and teachers' caring and education in their early ages 2-5 before they fully develop the language ability [3, 4]. ASD symptoms involve three common behaviors: a) difficulties with social interaction, such as avoiding eye contact with others, showing indifference to people, and difficulties expressing and sharing feelings and emotions with others; b) delays in language development, such as not talking much or difficulty speaking in sentences; and c) behavioral problems, such as focusing on one thing and an inability to

change their interests [5, 6]. It is easier to identify these symptoms after the child becomes able to talk. ASD experts suggest that parents build up their attachments with children by playing with the child [7]. The clothing items 'TellMe' were especially developed for children with under-responsive sensory processing problems, rather than hyposensitive symptoms. The symptoms can be treated and relieved with education throughout daily life over a long period. However, there is a lack of research on developing products for children with ASD. Therefore, this smart clothing has been designed to treat children with ASD symptoms by encouraging them to speak out and expressing their feelings and emotions while playing with the clothing. This will help parents, designers, doctors, and psychologists understand ASD and their treatment better. These small, initial steps are expected to bring larger improvements.

### **Technology**

Electronic parts were added that will encourage the children to speak and express their feelings, emotions, and opinions. Different types sensors (flexible film-like touch/pressure sensor, light sensor, and motion sensor); actuators (LEDs, DC motor, vibration motor); and a 3V coin cell and 9V battery were added. All of the electronic parts are miniature-sized for clothing applications. A microphone and a speaker were added to encourage the child to speak out while playing with the top. When talking on the microphone, which is placed on the right wrist, the speaker on the low chest side makes the sounds louder. When the child touches the pressure sensor, the DC motor and vibration motor will activate to express his feelings and emotions. If the child touches the light sensor on the top or the pressure sensor on the cap, LEDs will light up. Each

sensor and actuator was incorporated into the characters to symbolize special abilities on the top. By playing with the sense-interactive clothing, the child will be able to learn and express his feelings, emotions, and opinions. This clothing is expected to provide fun experiences and improve the child's confidence in expressing themselves, as well as help

### **Execution**

#### *Design Development*

The top and the cap were developed for boys aged 2–5 who show significant autistic behaviors and need treatment [3]. The top was designed as a casual top for comfort in daily life. The color of the top is bluish-gray, which can be matched with various colors of bottoms. The top is hand-dyed with blue color to create a soft, natural, and casual look. The pattern was developed using a flat patternmaking technique, and raglan sleeves were applied to the top in order to allow comfortable arm movements. The hemlines of the top are longer than those in the front, so that the children can move and bend their upper bodies without worrying about showing their innerwear. Soft fabrics were chosen to avoid skin irritation and to provide psychological relief. The cotton fabric, which is resistant to heat, was applied to avoid fabric damage by heat, which may be caused by the battery after long-term usage. The cotton fabric also provides comfort by absorbing sweat and it is durable for ironing at high temperatures. Stretchable rip fabrics were integrated into the neckline and cuffs for ease of removal and comfortable movement. The cap style is casual and matches the top and other varied designs. Images of the robot character's face are integrated into the top. Cotton fabric is also used because of its heat resistance, comfort, and ease of care.



**Figure 1.** 'TellMe': Therapeutic smart clothing for children with ASD

#### *Characters Development*

The majority of children on ASD lack social interactions and confidence [8, 9]. It is expected that wearing the clothing would help the children to express different emotions. Therefore, the robot characters which are the one of most popular prints of boys' clothing were created to symbolize the special abilities that children on ASD need to improve. The created robot characters are Speakerbot, Joybot, and Nobot. Speakerbot (top left on Figure 2) is talented at speaking and good at verbal communications. Joybot (top right on Figure 2), symbolizes positive feelings and emotions, such as joyfulness, excitement, happiness, as well as agreement with an issue. Nobot (bottom middle on Figure 2) expresses negative feelings and emotions, such as sadness, disinterest, or disappointment, as well as disagreement with an issue. By playing with these robot characters, such as by speaking into the

microphone or activating sensors and other actuators, a child wearing the garment can naturally learn and practice how to express his feelings, emotions, and opinions.

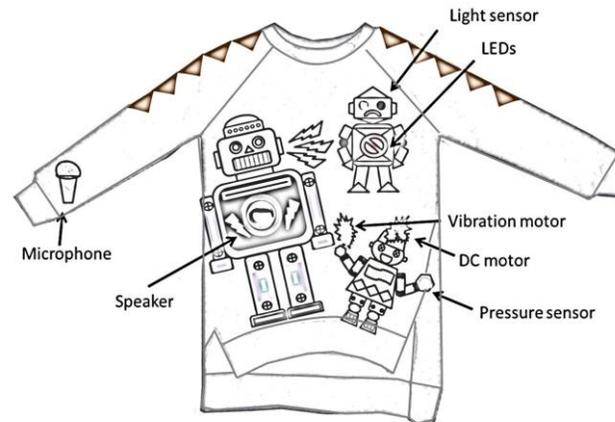


**Figure 2.** Robot Characters: Speakerbot, Joybot, Nobot

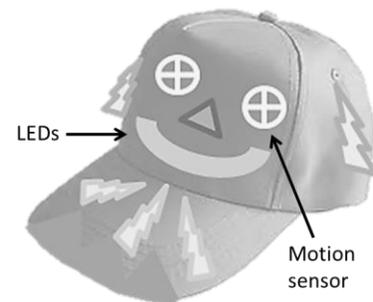
#### *Technology Application*

The robot characters were thermally transferred onto the top and electronic parts were embedded to the prints (Figure 3). The configurations of the electronic parts were divided onto both sides for weight balance, as well as to maximize movement ranges in the upper body and arms. For ease of use and care, all of the electronic parts are detachable, so that the top can easily be machine washed and dried to protect against bacterial infection for children who may have weak immune systems. Small pockets, snap buttons, and specially designed inner-tunnels were applied to the top. The mini-microphone is located on the right wrist, so that the child can easily speak into the microphone by folding his arm when playing with the top. As for the

cap, the smiling lips will light up with LEDs (Figure 4) when the motion sensor senses any movements near the eye prints such as touching the print.



**Figure 3.** Top design specifications



**Figure 4.** Cap design specifications

## References

- [1] Why Are Autism Spectrum Disorders Increasing? <http://www.cdc.gov/features/autismprevalence>
- [2] Autism Spectrum Disorder (ASD): Data & Statistics. <http://www.cdc.gov/ncbddd/autism/data.html>
- [3] Eaves, L.C., and Ho H.H. The very early identification of autism: outcome to age 4 1/2-5. *Journal of Autism Development Disorders* 34, 4 (2004), 367-78.
- [4] Goldstein, S., and Naglieri, J. *Autism spectrum rating scales (2-5 years) parent rating*. Multi-Health Systems INC, 2010.
- [5] Autism Spectrum Disorders. [http://www.helpguide.org/mental/autism\\_spectrum.htm](http://www.helpguide.org/mental/autism_spectrum.htm).
- [6] Symptoms: What are the symptoms of Autism? <http://www.autismspeaks.org/what-autism/symptoms>.
- [7] Tustin, F. *Autistic States in Children*. Routledge, 2013.
- [8] Chawarska, K., Klin, A., & Volkmar, F. *Autism Spectrum Disorders in Infants and Toddlers: Diagnosis, Assessment, and Treatment*. Guilford Press, 2010.
- [9] Autism Speaks. <http://www.autismspeaks.org/family-services>.