Chapter 11
Critical Behavior Monitoring for Children with Special Needs in Preventing Physical Injury Using Kinect

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ABSTRACT

This research studies ways to prevent physical injury for children with special needs, or specifically children with Autism Spectrum Disorder (ASD). The prevention is achievable by monitoring child behavior in the classroom from time to time. A Critical Behavior Monitoring model was developed for this purpose. The model is integrated with a Kinect sensor (by Microsoft) to process the signal acquired for human activities recognition. Currently, the model manages to identify 17 different human activities and notify parents or teachers via SMS and/or email if any unusual or critical activities are detected (i.e. falling down or asking for help). This will ensure immediate action is taken to prevent injuries or the situation from getting worse.

INTRODUCTION

Autism Spectrum Disorder is a severe neuro-developmental disorder that usually diagnosed in the first few years of birth i.e. year 3 (Levy, Mandell & Schultz, 2009; Lord, Cook, Leventhal & Amaral, 2000). The American Psychiatric Association (2013) defined ASD as Pervasive Development Disorder (PDD) which can be further classify as autistic disorder, Asperger's Disorder (AD), Childhood Disintegrative Disorder (CDD), Rett's disorder and Pervasive Development Disorder not otherwise specified (PDD-NOS) (Inglese & Elder, 2009). However, most literatures only include autistic, AD and PDD-NOS into ASD (Cavalari & Romanczyk, 2012; Johnson & Myers, 2007) as these three are the most commonly diagnosed spectrums.

Children with special needs especially Autistic Disorder, Asperger's Disorder and PDD-NOS have three challenging behaviors namely destructive behaviors, disruptive behaviors and interfering and/or irritating behaviors (Thorsen, 2013). The destructive behaviors such as aggression, self-injurious behavior, vandalism, and behavior that inflicts injuries to others by throwing or pushing using their limbs. Due to their motor skill deficiencies, they might harm themselves too. Other inappropriate conducts such as throwing tantrums, screaming, crying, repetitive noises and the lack of social skills could lead the initiator to be isolated from the community. The condition is heightened with interfering and / or irritating behaviors with different degree of social acceptance. It is common that they engage in self-stimulation, repetitive and preservative speech/questions, argumentative behavior and the inability to complete tasks, poor task completion poses as an obstacle for self-improvement and growth.

According to The National Autistic Society report (2013), self-injurious behaviors or activities initiated by these children such as head banging (on floors, walls or other surfaces), hand or arm biting, hair pulling, eye gouging, face or head slapping, skin picking, scratching or pinching and forceful head shaking could invite some involuntary injuries that need prevention. These incidents occur due to the inability to express their thoughts and to be understood by others (Mandasari, 2012). Sometimes, minor misbehaves may cause serious injury in classroom for example, a child could start a fight with their peers. The situation may get worse if no action is taken or stop immediately. These life endangered activities were classified as critical behavior in our research

An incident happens in Bournewood Hospital, Brookline, MA where a patient was found dead for nearly 6 hours for locking herself in her room. (Fraud, 2006). A commissioner in Department of Mental Health, Massachusetts, Elizabeth Childs reported to The Boston Globe that the incident might have been prevented if hospital workers had carefully checked her well-being every 30 minutes. Another similar incident reported by CALL7 (2011) where a mentally impair patient, Josh Garcia found dead in Colorado Mental Health Institute at Pueblo due to over dos drug consumption without proper care or companion. The autopsy found that the patient had more than 11 times the level of Haldol in his blood and caused constipation, which made his bowels burst. On top of that, the deceased's mother, Bonnie Garcia claims that this incident happens because her son was not being monitored and taken care of properly. In short, these two incidents could have been prevented if seamless automated injury prevention system was adopted in the disabled person's room and alert caretakers for immediate precaution action once unusual behavior or phenomena being detected.

Currently, most research works on assistive technology for children with special needs is mainly focus on learning specifically for language and social skills as well as speech therapy (Parker & Kamps, 2011; Gaylord, Quinn, McComas & Lehr, 2005; Tobii, 2013; Autism Speaks Inc., 2013). As to date, there is still a lack of real time intelligent ICT based tools to monitor, detect, recognize and alert in the occurrence of any critical behavior. In fact, continuous monitoring from time to time is required to ensure safety and to prevent these children from physical injuries which require tremendous manpower. Sometimes, a child is left unsupervised at home or in classroom. Under certain circumstances, no additional teachers are available for substitution as the number of manpower in the school is insufficient. These are the period where unwanted incidents i.e. fighting, harming each other, self-injury, over aggressiveness, hyper-tension and accidents may occur in the classroom (Plötz et al., 2012). The scarcity of the available tool to monitor the behavior of children with ASD in classroom leads this research to source for a good contemporary solution.

The next section will present some background studies, an in-depth discussion on previous works as well as overview of Kinect sensor followed

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