SAM: The School Attachment Monitor

Dong-Bach Vo[1]
Maki Rooksby[2]
Mohammad Tayarani[1]
Rui Huan[1]
Alessandro Vinciarelli[1]
Helen Minnis[2]
Stephen A. Brewster[1]

[1]Glasgow Interactive Systems Group
School of Computing Science
University of Glasgow, UK
{first.last}@glasgow.ac.uk

[2]Adverse Childhood Experiences Lab
Institute of Health and Wellbeing
University of Glasgow, UK
{first.last}@glasgow.ac.uk

Abstract
Secure Attachment relationships have been shown to minimise social and behavioural problems in children and boosts resilience to risks later on such as antisocial behaviour, heart pathologies, and suicide. Attachment assessment is an expensive and time-consuming process that is not often performed. The School Attachment Monitor (SAM) automates Attachment assessment to support expert assessors. It uses doll-play activities with the dolls augmented with sensors and the child's play recorded with cameras to provide data for assessment. Social signal processing tools are then used to analyse the data and to automatically categorize Attachment patterns. This paper presents the current SAM interactive prototype.

Author Keywords
Child Attachment; Attachment Assessment; Child Psychiatry; Automation; Social Signal Processing; Tangible Interaction; Child Computer Interaction

ACM Classification Keywords
H.5.0. Information interfaces and presentation (e.g., HCI): General.

Introduction
Attachment is the natural tendency of children to seek and to maintain the physical proximity with their care givers which provides protection and nurtures physical and psychological wellbeing. While it is a primitively-

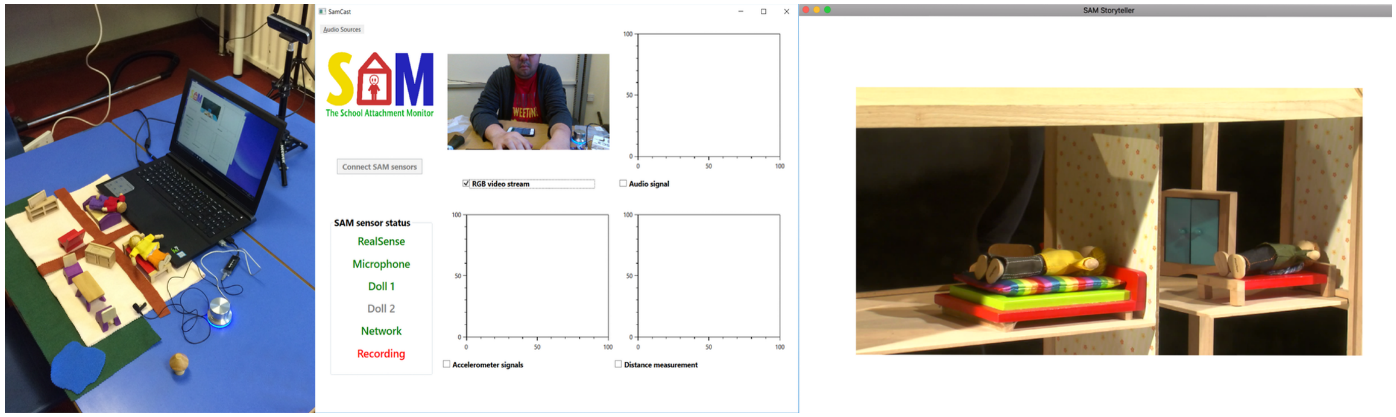

Figure 1: From left to right, SAM setup, SAM data collection application and sensor monitoring, SAM administration application.

motivated process to ensure survival of the species across humans and the animal kingdom, insecure attachment may reflect inconsistency, absence or hostility in the quality of care their young receives [1].

Secure Attachment can nurture confidence and sense of self-worth in children. Research suggests that it also provides the child with resilience against risk of suicide, social and emotional problems or even heart pathologies [2]. Early identification of attachment misalignments would therefore minimise these risks to the individuals thereby also ameliorating the societal costs. Unfortunately, administrating and coding Attachment evaluations is costly, time consuming and requires highly-trained assessors [4]. This limits the number of children that can be assessed and referred for treatment. Automating Attachment evaluations would facilitate population screening and allow health care professionals (i.e. expert assessors) to prioritise their expertise for those in need of intervention. Our vision is that our School Attachment Monitor (SAM) will provides the tool to make automatic attachment and population screening possible.

SAM is designed to reflect methodology and principles of the MCAST [3], the gold standard for measuring Attachment in children. The MCAST is designed to assign the child in school age to one of the four possible attachment conditions that can be observed: *interpersonal (secure) strategy*, *non-interpersonal (avoidant) strategy*, *ambivalent interpersonal strategy* and *disorganized strategy*. During MCAST, assessors show vignettes to a child which portray mildly stressful situations (e.g., falling over and hurting a knee). The child is then asked to act out and tell the rest of the story using dolls that each represent the child and a caregiver. The way the child completes the story and their behaviour during the test provides the cues to assess their Attachment status. For example, the trained assessors

Figure 2: Smart dolls given to children during the SAM assessment. At the top of the figure from left to right: a Tinyduino computer, an inertial sensors module and a Bluetooth low energy module.

To equip the dolls with computers, their body was replaced with a small 3D-printed empty case. Thanks to this modification, the dolls can host a small Arduino computer powered with a cell coin battery, and a set of stackable modules to enable inertial sensing and wireless communication with the SAM data collection application.

rate on Attachment-related behaviour, narrative coherence, disorganized phenomena (if any), state of mind and the psychological motivation of the characters and any other elements relevant to the story. In this paper, we outline the design of SAM.

SAM: The School Attachment Monitor

Our aim in SAM is to provide a tool to allow a non-expert to administer an Attachment assessment (based on MCAST) and automatically categorize the Attachment status of the child. SAM is made of three pieces of software: to collect data, to administer the test, and to process the data to make an Attachment classification. This paper discusses the first two parts. SAM is based around a laptop so it is easily portable and can be taken into schools for assessments.

The first application collects data when the child is telling a story (Figure 1, centre). Tracking the movements of the dolls is difficult given the wide range of manners in which children may play with them. We overcome this by using a novel combination of tangible dolls with embedded sensors and depth camera tracking so that the child being assessed can handle and play with dolls as they would in MCAST, without the technology interfering their play behaviour. An Intel Realsense SR300 camera (http://j.mp/RealSenseTech) is used to record RGB and depth data depicting the face and the hands when the child tells the story using the dolls. The small size of the SR300 sensor allows ease of transport. A lapel microphone worn by the child records their speech. Our initial designs used the microphone in the RealSense and the laptop but were not robust to the wide range of noises from children activities that can occur during the school day. Finally, a Bluetooth inertial measurement unit is embedded in a 3D printed case inside each doll (**Error! Reference source not found.**). Orientation and acceleration are features used in the assessment of Attachment. Having the sensors in the dolls allows us to track movements even if the depth camera cannot see them; they may for example be obscured by the child's hands or hidden under the table during play.

Several challenges had to be overcome before a functional prototype for collecting data was released. Recording the data coming from all the sensors at the same time was difficult. For instance, recording high definition RGB and depth data at the same time requires a significant amount of storage, bandwidth and computing power. Our final approach, which operates in real time, relies on running simultaneously FFMPEG (https://ffmpeg.org) on the GPU to compress and encode the RGB video stream, and an LZ4 based algorithm on the CPU to compress depth data. A SSD drive copes with the high demand of data bandwidth. A Bluetooth Low Energy stack and a mechanism to synchronize the inertial measurements with the other data streams was developed and deployed on a Tinyduino (https://tinycircuits.com) fitted inside each doll (Figure 2).

The second piece of software delivers the story vignettes to children and engages them in acting out the stories with the dolls. Implemented using Unity, it has been designed as a game. The application starts by playing a video sequence where a professional actress introduces the task and what is expected from children. The children are then prompted to set up the playground according to the story that is about to be told.

Following a workshop run with young children to investigate how they could communicate with SAM, a "smart" push button was included to the setup. For example, when the children have finished setting up the playground up and are ready to listen to the story stem, they press the button. Another use is to notify the system when the child's story is complete. While carrying different actions, it simplifies the interaction with the system.

SAM Demonstration

In this demonstration, we will exhibit two components of SAM: the data collection and the story delivering applications. The attendees of IDC will be able to experience SAM as an administrator by monitoring all the sensors the system is using to collect data from the children's stories and by examining the different types of data that are being collected. They will also be offered to experience SAM as a child who is being administrated the attachment assessment by watching the story stems and completing the stories with the dolls.

Practical Consideration

SAM development has already reached an important milestone. The current prototype has been evaluated and used to collect data from 30 children in primary schools. This version of SAM is reliable and can be exhibit to the conference attendees. The setup only requires a single power socket since the input accessories are powered by the laptop and the dolls only require cell coin batteries.

However, designing SAM is an ongoing effort. An adult is still required to introduce the application to children and to explain how and when to use the SAM interactive inputs. Our current work focuses on investigating new ways to support and teach young children how to interact with the system in order to reduce adult supervision. Progress from this research will be integrated to the SAM prototype for the demonstration.

Acknowledgements

This research was funded by EPSRC grant EP/M025055/1.

References

1. John Bowlby. 1988. A secure Base. Routheldge.
2. Maxia Dong, Wayne H. Giles, Vincent J. Felitti, Shanta R. Dube, Janice E. Williams, Daniel P. Chapman and Roberta F. Anda. 2004. Insights into causal pathways for ischemic heart disease. *Circulation*, *110*(13), 1761-1766. https://doi.org/10.1161/01.CIR.0000143074.54995.7F
3. Jonathan Green, Charlie Stanley, Vicky Smith, & Ruth Goldwyn. 2000. A new method of evaluating Attachment representations in young school-age children: The Manchester Child Attachment Story Task. *Attachment & Human Development*, *2*(1), 48-70.

   http://dx.doi.org/10.1080/146167300361318
4. Helen Minnis, Reuben Millward, Claire Sinclair, Eilis Kennedy, Anne Greig, Kate Towlson, Waren Read and Johathan Hill. 2006. The Computerized MacArthur Story Stem Battery. *International journal of methods in psychiatric research*, *15*(4), 207-214. http://dx.doi.org/10.1002/mpr.198