Saathi: Making it Easier for Children with Learning Disabilities to understand the concept of Time

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Abstract
Children with learning disabilities have been found to perform poorly in understanding abstract concepts such as the concept of time as compared to normal children. Our project, taps on the ability of students to understand concepts with the help of objects and visuals they are accustomed to. Saathi is a smart watch which instead of displaying time in the form of numbers uses visuals, audio feedback and images from the daily life of children to give them an understanding of the concept of time and is aimed at generating a sense of individual task pace. Owing to the functionality, this watch will also promote a deeper sense of association in the child (the primary user) with his parents/teachers (the secondary user).

Author Keywords
Learning disability in children; time perception; self-help; scheduling of daily activities; communication; graphical representation.

ACM Classification Keywords
H.5.2 [User Interfaces]: User centered design, Voice I/O, Screen Design; H.5.1 [Multimedia Information Systems]: Animations.

Figure 1: Pictorial Flash cards (At Shishu Sarothi)

Introduction

Managing time is very important for everyone and often turns out to be challenging. When it comes to children with learning disabilities, the challenges magnify. There is a huge difference in understanding the concept of time as compared to reading the clock time itself. In many cases, students needing assistance can read the clock perfectly well, but when asked to estimate how long an assignment will take, there is an absence of the sense of individual task pace [11]. Further, we generally tend to assign more time to those activities which one feels important, relevant or engaging. Prioritizing things is very important for these children as well, so that they can feel a sense of balance and stability in their life, and for the same reason, they need to get a better understanding of time. So far, the model of technology development has often neglected populations who present needs outside of the norm.

Preliminary Research

The process began with developing an understanding about assistive technology through various journals and research papers in the field. The current work in this field includes technologies like alternative keyboards, gaze interaction technologies, electronic pointing devices and touch screens, braille embossers, text to voice software and so on [10]. A collection of videos each focusing on these technologies, also helped to gain insight into the experience of the users.

Field Visit and Contextual Inquiry

Shishu Sarothi: a center for rehabilitation and training for multiple disabilities, which has specially abled children enrolled from the infant age group up to twenty years of age, was chosen for the purpose of field visit. Specially abled children having Cerebral Palsy, Autism, ADHD, etc. were observed in their classroom environment and setups like the computer center, multisensory room, leisure learning classroom and while playing. Subsequent visits were aimed at discussions with the special educators with an experience of above thirty years in dealing with similar children. Diary entries, contextual inquiries and observations were made about the behavior of children while playing, writing, drawing, eating, commuting, communicating etc.

Narrowing down to the problem statement

Affinity Analysis of the observations from the field visits helped in identifying the domain for further work as self-help skills out of domains like cognition, language, motor, self-help and social skills. Self-help as a domain has a lot of scope but has limited existing solutions. The next couple of visits to the rehabilitation center were aimed specifically at working out possible solutions in the area of self-help. Various areas of interest like poor reflexes, natural hazards, self-activities, behavioral problems, organizational skills and so on were identified.

Finally, 'Lack of time perception' was chosen over others primarily due to two reasons. First reason being that the domain has largely remained unexplored and carries a huge potential, and the second being that it provides an opportunity to interlink one of the primary needs of the child and the teacher/guardian. The idea was also supported by experts from Shishu Sarothi.

Competitor analysis

Past works in this field have dealt with the problem of daily time management in children with disabilities [6]. Projects have been aimed at developing instruments to

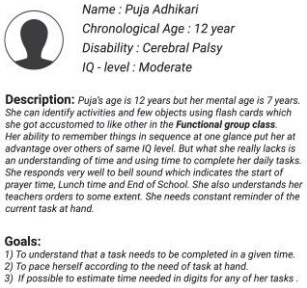

Figure 2: Personas of mild & moderate IQ level children to understand basic needs.

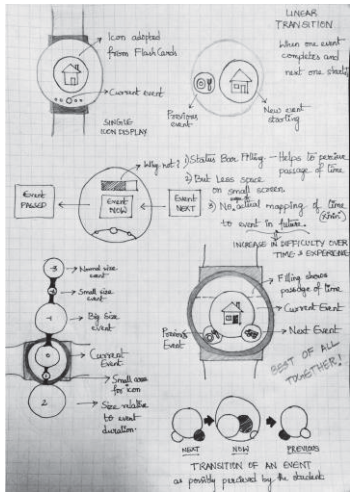

Figure 3: Concept Sketches exploring display of graphics and event transitions.

improve time processing ability, however they all need a specialist or a medical professional to guide through the process [7]. Most of the available products like Watchminder [3] and Time Timer [16] which try to tackle the problem of difficulty in perceiving time, lack metaphorical clues from the real life activities of children. iPrompt [5], is another product for helping children with learning disabilities perceive time. However, being a mobile application it is quite complex for a child with learning disability to navigate through. Work by Lovisa Rönmark also investigates the use of cognitive artifacts, however there is not much that has been done based on the findings therein.
Our proposed solution Saathi, highly draws its inspiration from the thesis project by Rönmark and is compiled in a way of looking at the artifacts in order to investigate what properties they should have to support the ability of understanding time. The proposed solution here aims to bridge that sense of gap in case of children with learning disabilities by using visuals and sounds in a manner that they can relate to.

Solution

Saathi is a step into the conceptualization of a device which would assist a child with learning disability in getting a better understanding of time. It aims at tapping the familiarity [8] of children with school exercises and voices of guardians or special educators which they are comfortable with, to induce the concept of time. Because of the manner in which they are taught in schools, these children relate especially to certain things like a flash card. Saathi uses visuals like an alarm clock to denote the morning, a school bus to denote the time for school, color filling up to denote the timer, children not only get a sense of time but also can relate to it in a better way than simple numeric or hand displays that we have in normal watches. Also, the feedbacks in any form, should be gradual so that they do not induce a scary effect [9, 17].

Two integral parts of the idea are the children with learning disability (primary user) and his/her teachers/ caretakers/ guardians etc. (secondary users). The primary user can see time; check past, present and the upcoming event. These events will be mapped from his/her daily activities in the form of simple verbal graphics, similar to the ones they are used to in 'Pictorial Flashcard's' (see figure 1). Transition of events graphically induces a sense of time in the user. Further the watch also reminds the primary user about the completion of events using voice reminders created by teacher/guardian. There is a provision to change the frequency of reminders for an event according to varying interest of person for particular event [4] e.g. more reminders during playtime.

The secondary user needs to be the one who has keenly observed primary user, his/her day-to-day activities, time spent and interest in particular activity (suggestedly parents, guardians, teachers etc.). The secondary user is the one responsible for creating sequence of events and the number of reminders required to notify the primary user for each event.

Working

Considering real life situation, the flow of usage can be represented as:

- Parent/Guardian(Master) buys the watch
- Syncs with his/her mobile
- Makes profile of the primary user

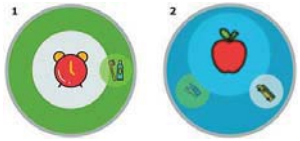

Figure 4: Transition Type 1)Linear and 2)Circular

Figure 5: Saathi Concept Graphic Representation of Events.

- Set Time Table for his/her time-slot(for which he/she is responsible for primary user)
  - View pre-sets
  - Customize timetable by adding /removing events by assigning event flashcards or custom images.
  - Customize number of reminders for that event
  - Record personal voice as reminders
- Student goes to school with watch
- On installing mobile application created for such watches, teacher (Admin1) sees visibility of new watch in vicinity, in her mobile (assuming parent told teacher about it)
- Clicks 'set timetable' for which a query is sent to parent (Master) asking for permissions to edit school-slot timetable.
- After following the above step, new watch gets added to Admin1's list of accessible watches.
  - All Admins can change their part of timetable for a particular watch.
  - Can view rest of day's timetable of student without overwriting it.
  - Can suggest changes for rest of the part (except theirs) to the Master.
- Master can pass forward/ change/ view any Admin's time-table slot.

Prototyping and User Testing

For the purpose of user testing, an animated sequence was played on a Philips Go Gear Video Player. The video player was attached to the bands of a wristwatch and the animation sequence was played where transitions happened over a span of time. For the transition from one event to the next, two transitions were considered namely the linear transition and the circular transition (see figure 4). Starting with the low fidelity wire framing using graphics from the pictorial flashcards, which the children used at school, were developed subsequently. Special attention was paid to the colors where the background gradually gets filled thereby representing the time running out. Also, to increase the visibility, the colors were chosen to develop contrast between the foreground and background. Since familiarity of voice was necessary and reminders needed to be in native language, the same were recorded by the special educators /guardians themselves beforehand.

The user base comprised of children (age group 9-14 yrs) from two categories. These categories were made on the basis of cognition level (mental age) of the children rather than their chronological age. The "Mild Category" had children with an IQ in the range of 50-69 on the Wechsler–Bellevue Scale whereas the "Moderate Category" had children whose IQ ranged from 35-49.

It was observed that the participants in the user study from the Mild Category fared better than most of the participants from Moderate Category. Also, Saathi could be targeted more effectively for the Moderate Category because in comparison to the Mild Category, these children were more dependent and the possibility of effective intervention was more. However various points surfaced from the user study which had not been considered earlier. Circular transitions were taken up by the children very easily in comparison to linear transitions. Further, even though the users could easily identify the graphics and perceive time based on the same, the use of real pictures in place of graphics could make Saathi more effective based on the feedback from the special educators. The proposal of multiple

reminders for an event affected the attention of children negatively while doing an activity, instead snooze button could be thought of as a better alternative. It was observed that long descriptive messages were not easily interpreted by these children. Replacement in the form of prompt messages could be chosen as reminder.

Discussion

The special educators pointed at the need of gradual but essential learning of real world clocks (analog/digital), for which the idea of difficulty levels was proposed in watch, according to which: Elementary level: Only visual schedule; Intermediate level: Visual schedule with analog clock (with hour hand only); Advanced level: Visual schedule with analog clock (with hour and minute hand only).

In future, we look forward towards accommodating children with high support needs like, pointing at the watch to communicate immediate requirements e.g.- going to toilet. Further reminders mentioning positive reinforcement could be a better way to grab attention. Though the above discussed solution might increase child's ability to develop a sense of control over their environment but the problem strikes when there is change in their routine, which they find quite difficult to accommodate as pointed out by the special educators. This could also be an area which can be tapped upon in the future.

Conclusion

This paper tries to explore new paradigms to perceive and interpret time, making it more universal in terms of cognitive ability of an individual. It tries to capture the essence of time from their own daily environment, like making use of time cues, both internal (e.g. feelings of hunger) and external (e.g. the ringing of the school bell) to deduce the time. These signals are reinforced by the use of time labels, such as 'lunchtime' or 'playtime', so that the child eventually learns to pair an event with a time label and then sequence events throughout the day.

The solution presented also tries to strengthen the relationship between the parents/ teachers and the child by valuing their role in the child's life, giving them the opportunity to create time schedules for the child which eventually helps the child get a sense of control over their lives.

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