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# KidLED: A colorful approach to children's activity awareness

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## ABSTRACT

Obesity in children is a growing cause of concern as it affects more than 18% of children in the United States. Sedentary behaviour is one of the contributors to childhood obesity. Technological interventions like activity trackers and fitness games have been introduced to motivate both children and adults to be physically active. Most of these technologies encourage activity by making them aware of their activity levels. While awareness of current activity levels may help motivating adults, it can be difficult for children to understand their activity levels in terms of number of steps (the most common method used by adults). Instead children should be made aware of their activity levels via simpler and easier to understand technology. Within this context, we present KidLED – an LED activity display that represents user's activity via a simple color display rather than numbers – designed to simplify activity tracking for children.

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**CCS CONCEPTS**

• **Social and professional topics** → **Children**; • **Human-centered computing** → Participatory design.

**KEYWORDS**

social, temporal, active games, activity minutes

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**INTRODUCTION**

Childhood obesity is a growing epidemic. Obesity in children not only affects their physical health with early onset of diseases but it also hampers their overall social and emotional wellbeing [3]. In response to these issues, a wide variety of wearable fitness technologies are available for both adults and children. Fitness trackers like Fitbit Ace, Garmin are now available with designs specifically for children, with the intended audience for most of them being children 6 years of age and older. Most of these trackers display activity in terms of the number of steps, distance covered, or active minutes. For young children, understanding and interpreting their activity in terms of a number of steps or distance can be a challenge. Our research design is to display a user's activity via changing the color on an LED device named KidLED. As the concept employs an easy-to-understand color light display, it can be used and understood by children as young as three years old. An added sound or haptic feedback like vibrations on achieving different levels of activity can contribute towards children's engagement with the technology and make it also usable for visually impaired or illiterate children.

**CONTEXT**

There has been a lot of research examining tools that can promote activity in children. [8] states that providing children with experiences that they enjoy has the potential to increase their activity levels. Combining physical activity with childhood fun and play was also found to be motivating in engaging children to be physically active [6]. One element that children enjoy and use for distinguishing between objects is color [1]. Stratton and Mullan [7] for example marked playgrounds with multi-color markings and found significant increases in moderate to vigorous physical activity and vigorous physical activity in school interventions. In addition, LED displays have been utilized to facilitate communication in social groups to inform users and their peers of any messages received via an LED in the periphery [9].

While the aforementioned research has used elements that are preferred by children and have been found to be motivating, current fitness technology do not employ these findings. The Fitbit Ace is a popular children's fitness tracker which represents activity data via colorless display of numbers. The Garmin vivofit Jr. is a similar tracker, which has a lot of colors and themes on the band but the activity display is still colorless and very similar to fitness trackers for adults. Children have different expectations, utility and goal as they interact with technology. Unlike adults, children may not be able to interpret their activity in terms of steps or just numbers may not be motivating enough for children. Fitness technology designed for children should be easy to use and understand, easy to learn [5] and should engage children in a fun and playful manner [6].

Colors are a powerful form of communication. Children generally use colors to convey their thoughts and emotions [2]. Colors can also help children distinguish and classify objects [1]. Reading bright colors than reading number on muted shades of black and grey on a tracking device is much easier for even younger kids. Colors appeal more to younger children as they are easier for them to see and perceive [1], however most of these only utilize colored bands as a personalization mechanism. While most current fitness trackers are designed to be used by children ages six and above, a fitness technology that utilizes color as a representation of activity level can be utilized by children even younger than six. KidLED utilizes the primary colors yellow, blue and green to make children aware of their activity levels and easier for them to read.

In one of our previous research endeavors [6], we found that children preferred engaging with fitness technology that integrates a social element. Social interaction lets children interact with their peers on subjects of physical activity and lets them share their activity through the day. It also makes the activity fun and playful. KidLED proposed here aims at utilizing the component of social interaction by letting children share their activity via a simple colored light on their device. The color of the display is intended to motivate children to meet their daily activity goal, when they see other children who have already met theirs.

#### **PROJECT BRIEF: INCEPTION OF THE IDEA**

Our research group works with and participates in an inter-generational design team (Kidsteam) where children and adults collaboratively design and develop technologies for children using the Cooperative Inquiry method [4]. The team meets twice a week during the school year for 90 minutes sessions.

In one of our design sessions with Kidsteam, children developed an idea of a smart shirt that changes colors. The color of the shirt at any instant reflects the user's activity and an emoticon on the shirt reflects how they feel (a smiling face for happy and a frowning face for sad). The shirt would fit everyone and sense when a user is sick and unable to engage in physical activity, and under such circumstances the shirt would not display their activity but get warm and makes them feel better.

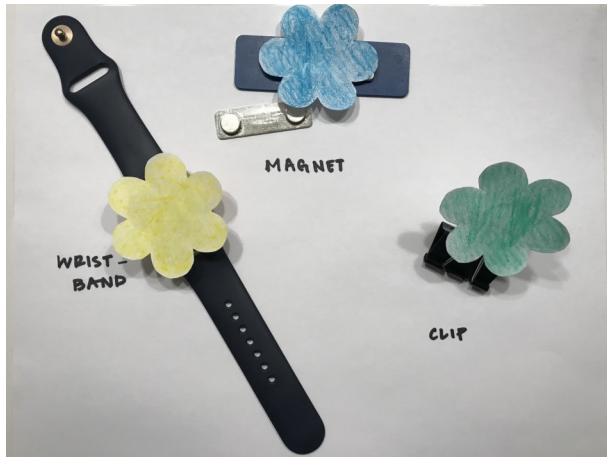


Figure 1: KidLED initial prototype.

Building on this idea, we propose KidLED that lets a child know their activity throughout the day by means of color-changing LED wearable. The device is intended to be as small as a brooch or a pin (see Figure 1) so it could be worn on your clothes, kept in a pocket, or clipped to a wristband or hairband. The small size of the device makes it easy for the user to carry, wear, or put it in pocket when they do not want to share their activity with their peers similar to how the suggested shirt would “deactivate” when the user was sick. The device is intended to be used by children 3-11 years of age.

### LED ACTIVITY DISPLAY

KidLED is a device that utilizes colors to make children aware of their activity levels. The simple representation of user activity via a progression of colors is easy to understand and interpret by children. User’s activity is presented via three colors: yellow, blue and green. Each day starts with a yellow LED showing little or no activity, as the user gets 50% of their activity goal, the LED changes to blue. The LED turns green when the user has achieved their daily goal. Red is purposely avoided so as to not give a negative or demotivating vibe as red is sometimes considered the color of danger.

Beyond just a concept, we are working on a working prototype of KidLED which integrates with a mobile application which communicates via Bluetooth with KidLED and utilizes the Fitbit activity API. The mobile application gets user authentication to access their fitness data and fetches data from the Fitbit server such that the data reflects the last activity synced on the Fitbit app. The application then computes the color of the LED to be lighted on the device based on user’s current steps and the step goal set by them in the Fitbit app. Upon computing the LED color the app communicates this to the LED display. Color changes are also accompanied by a slight vibration of the device which facilitates notifying the user if the device is in their pocket or bag, or if the user is paying attention to something else. It also makes the device usable by visually challenged children who might not be able to see their progress through colors but can sense the vibrations. The mobile application also has the control to turn the device on or off to let parents control the usage of device at certain places. If parents do not want the light to disturb their child during the night, or in the school they can choose to turn it off.

The KidLED mobile application currently relies on fetching activity data from a Fitbit device which currently would also have to be worn by the child. Because it relies on this device, parents have to make sure that the Fitbit device syncs in order for the correct light to be displayed on KidLED. Since KidLED communicated with the app via Bluetooth, the child’s activity can only be updated once KidLED is within bluetooth range from the phone. While this is additional overhead of needing an additional device, it also means the user does not have to have or be looking at a phone the whole time. In the future, a simple step tracker or pedometer could be integrated with

the KidLED device, that computes the steps and activity and changes the color of the device (thus negating the need for a Fitbit device). This simple device of a tracker and a single LED would make for an even lower-power draw enabling the battery/power to last longer than many other fitness trackers. It would also reduce the task of syncing information between two applications (the Fitbit app and the KidLED app) and allow all information to be managed by one app (the KidLED app). However having it integrated with Fitbit facilitates to choose steps or active minutes as activity measure as Fitbit measure both. A simple pedometer does not measure heartbeat and hence the active minutes. Thus while our current implementation relies on activity data from Fitbit, it affords more flexibility in terms of measuring activity levels.

Unlike some activity trackers or smartwatches, which are usually heavy and bulky for the wrists of young children. KidLED is designed to be as small as a pin such that the child can wear it on their hand, clip it to their bag or clothes, or wear it on a bracelet, necklace or hairband.

Based upon these key points, KidLED can be generally described as: a way to simplify modern day trackers in a way that is more relatable and appealing to children.

## CONCLUSIONS AND NEXT STEPS

In summary, KidLED provides children with a simple and easy to understand representation of their activity levels. Combining a colorful visual display with fitness tracking enables activity awareness to children and their peers about their physical activity in order to increase activity. The simple display of activity via LED colors is easier for children to understand and compare with their peers. Seeing their peers using the device will motivate children to reach to their goal and get their LED's to turn green thereby promoting activity.

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