OMNICOM; a communicator for autistic people.

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OMNICOM is a discrete, watch-style two-way communication device that provides a solution for autistic individuals who require an additional layer of support from another person in situations where they may be unable to fully express themselves in a typical or socially acceptable manner. When there is a barrier to transparent communication, distance, or being around peers, OMNICOM gives the users a simple way to communicate with each other transparently, without being under the watchful eye of others. In an overwhelming situation, there is no longer a need to suffer in silence, but either user can instead easily send a message to the other explaining how they're feeling, without the use of complicated sentences or having to speak out loud. Instead, select your message by rotating the watch face and hold down until it buzzes to confirm it's sent using OMNICOM's two-way LoRa communication. Once on the other side, the other user receives a buzz to nudge them into looking at the icon, immediately being able to see the communicated state.

I. Introduction / Background

Around 1% of the population are autistic. That's over 75 million people! Many are diagnosed in childhood, before the age of 4-5. For these children, it will only get harder to find support once they grow up, even as soon as further education and entering early adulthood. Once no longer perceived to be a child, there is an expectation of independence that some autistic young adults are not yet ready for, or never will be.

Autistic individuals can often find situations in unfamiliar places or around unfamiliar people difficult to navigate and overwhelming. Many autistic people prefer to navigate new situations with a familiar and trusted person, but in social settings it can be difficult to communicate with this trusted person in a socially acceptable manner. For example, not being able to communicate that they would like to imminently leave, in a situation where it is inappropriate to pull out a phone and begin messaging, is rather difficult. To add to this, many autistic people 'shut-down' when overwhelmed, and can render them into a non-verbal state. If a solution is not found then it can lead to these needs being unmet and can lead to high levels of distress and panic.

In early years, it is more than acceptable to have an almost permanent form of support in parents, or an older sibling, with us at all times. However this often shifts - whether for autistic people or neurotypicals – to being centred around their friends, or a romantic partner – often also autistic.

Omnicom allows a discrete method of two-way communication of these needs, reducing the situation to clear, easily selectable options to allow for ease-of-use in stressful or busy situations and making the communication process require far less mental processing than almost anything else.

II. Related Work

Fig. 1. Autistic-aimed communication products

Many forms of low-processing communication rely on pre-set options. This is a great way to reduce mental load for those who are overwhelmed, reducing the effort needed to put complex sentences into words and manually type them out. However, the current methods of these pre-set methods of communication are extremely difficult to use and also extremely difficult to use in a discrete or private way.

Fig. 2. AAC Device

Another common method of communication commonly used for autistic people are AAC (Augmentative and Alternative Communication) devices. These iPad-like tablets come with preset common phrases and word-banks, more commonly enabling those with more permanent non-verbality to communicate. These are extremely uncommonly used by autistic people who do not struggle with speech the majority of the time, as they have a learning curve and are again, not discrete and are difficult to use and carry around with you. The other issue with these devices is that they continue to carry a theme with a negative association. Bright colours, round shapes and big pictures, all have a childlike look to them – a stereotype most autistic people are desperate to get away from. One search for 'fidget toy' and this issue is demonstrated clearly.

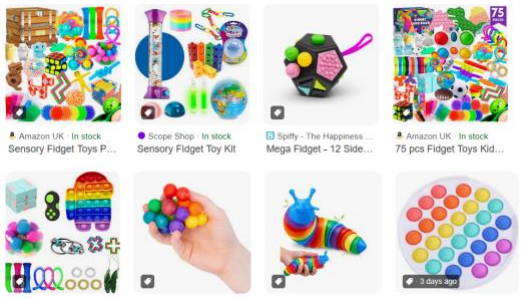

Fig. 3. Google search of 'fidget toy'

Some companies have picked up on the gap for products for autistic adults, and are beginning to produce professional stim devices.

Fig. 4. ONO Fidget Roller

III. Imagined or existing prototype sketches/drawings/photos

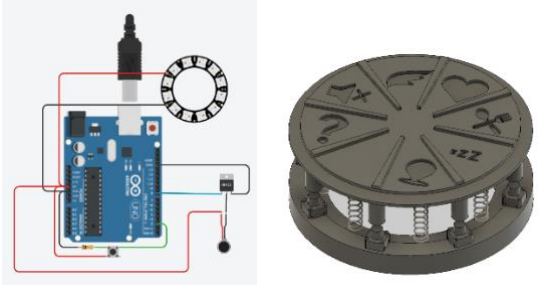

Fig. 5. OMNICOM Arduino UNO Circuit draft and first CAD ideation of watch face

A. Initial Ideation

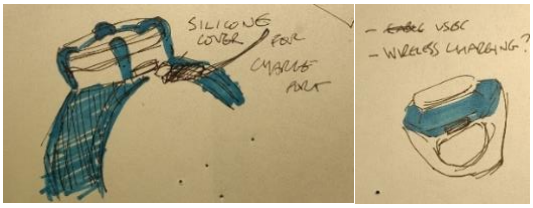

Fig. 6. Two initial wearable ideas

The solution of a small wearable stood out from the very beginning, with many early form factors taking shapes such as rings, bracelets and necklaces. These were all considered, but ultimately due to familiarity, versatility and some hardware specifications, a watch form was chosen.

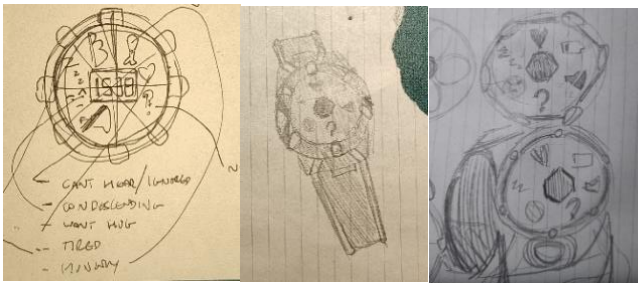

Fig. 7. Watch exploration

The form and mechanism design came hand in hand. After more design iteration and exploration on the shape and form of a watch, it was decided that the watch face would be segmented into slices, with an icon in each representing a different communicated need/desire. The initial sectors were; Hungry, No talking, Tired, Angry, Low social battery, Confused, Location Request. These were roughly chosen from my own experiences of having to communicate these states.

B. LED watch face and vibration feedback

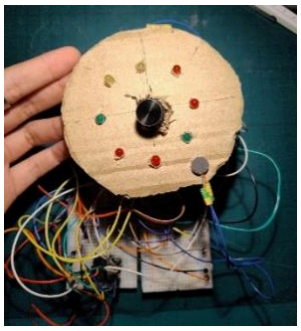

Fig. 8. OMNICOM Rotary Encoder Prototyping

To make the signal sending clear and to avoid any miscommunications, a simple system is used. First, the user rotates the face of the watch, and as each option is selected, the icon lights up with a unique LED colour to show which has is highlighted. To send this message to the other user, the person would then press and hold down the watch face, and after a few seconds, the watch vibrates to confirm that the message has been sent. Upon receiving the message, the other user feels a short vibration to communicate they should look at the incoming message. The corresponding LED icon is then lit up to show them which message has been sent. Vibration was chosen due to two main reasons – being discrete, and being un-missable.

Video of basic functionality:

https://photos.app.goo.gl/m2VFeC5byUtcjV2U8

C. Wireless Charging

Although the XIAO has a USB-C charging port, wireless charging allows the user to have a unique main charging method (likely set up on a bed-side table) where the cable cannot be lost or taken, rendering OMNICOM unusable.

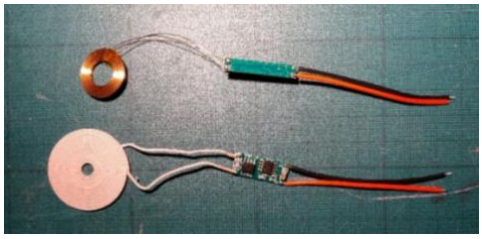

Fig. 9. Wireless charging coils

The USB-C port has not been removed as this is still a good backup charging method, but wireless charging minimises the risk of damage to the port, and encourages a habitual charging routine by having a constant docking station.

D. Form and Size Limitations

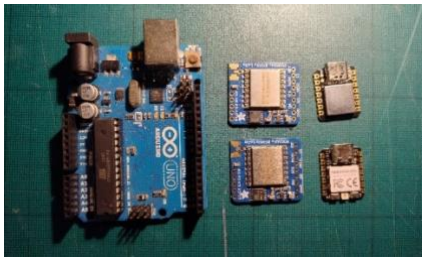

Fig. 10. Arduino UNO, AdaFruit LoRa Modules, XIAO RP2040

Small wearable electronics have become increasingly commonplace. Prototyping for the OMNICOM has so far been carried out on an Arduino UNO, but the next stage of prototyping was planned to use a XIAO RP2040, in conjunction with the AdaFruit LoRa module.

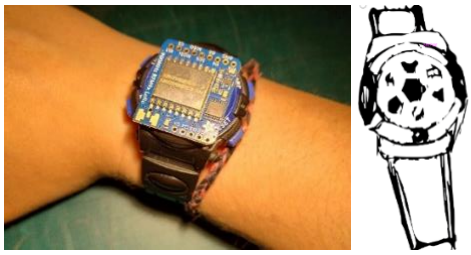

Fig. 11. AdaFruit LoRa Module on watch face size comparison

The Adafruit LoRa module was the largest component of second round of prototyping, neatly fitting over my everyday watch face.

E. LoRa Communication

To enable the mid-range communication, it was determined that LoRa (Long Range) Radio communication was the best form of communication. To improve the understanding of range and speed of transfer, a case study was conducted around an autistic couple, both attending the same campus university that would use OMNICOM to communicate throughout the day.

Whilst in lectures together or in group work meetings, user A could easily warn user B that their hunger is the reason for their irritability, not for anything that user B could be concerned about. If unable to find each other throughout the day, user B could sent a location ping, prompting user A to share their location. At a busy lunch table, user A could send the 'No Talking' symbol to show that they have entered a non-verbal state and that they may wish to not be overloaded with questions. At a late event whilst talking to other people, either user could signal the 'Zzz' symbol to show they're tired and would like to leave. Small points of contact such as this that would otherwise go unsaid and build up can be easily communicated, allowing for a far smoother and reassuring day.

These examples show that the range must be roughly campus sized, able to penetrate buildings, and be almost immediate. Due to the small amounts of data being sent and received, (LED on or off, vibration on or off) LoRa's 0.3 kbit/s to 50 kbit/s is sufficiently fast enough, with the concern more to do with range and penetration.In high density urban environments, LoRa has a range between 2 – 5 km, perfect for the desired application.

F. Future Improvements

Firstly, due to the size constraints of the device, a custom PCB would be necessary to reduce the size and thickness. This would make the device more comfortable to wear and potentially allow for a larger battery, increasing the amount of battery life and duration it can be used for without charging. The pro^2 summer school would be a fantastic opportunity for me to learn how to create a custom PCB, as well as receiving invaluable feedback on OMNICOM, a project which I am passionate to take further and be able to hopefully one day scale up to making many to help as many people as possible.

IV. Responsible Innovation

From the very beginning OMNICOM has been about enabling independence. The UK university dropout rate is around 6%. The UK university dropout rate for autistic people is around 30%. As someone who has been close to being in that 30%, something like this device could have changed how I approached the difficult social situations that were taking an everyday mental toll on me, making keeping up with academia near impossible. Improving methods of supporting autistic people socially after childhood is vital to ensure that in the same way autistic people are supported academically at university (extra time in exams, specialist tutors, etc.), they can also be supported socially.

V. Author Bio(s) / Experiences

Hi! My name is Michael, and I'm currently a 3rd year Design Engineering student at Imperial College London and elected Operations Manager 2 years running of the Design Engineering Maker Workshop (IDEAS Lab). I'm responsible for upkeep of 20+ 3D printers, including MarkForged, FormLabs and PRUSA. These printers are used by over 400 students – who use the space for rapid prototyping.

At the moment, I'm working as a Design Engineering intern at The Tyre Collective– a cleantech company aiming to collect the tyre wear microplastics that end up in our atmosphere using electrostatic plates mounted behind the wheels. I'm putting my skills practical skills to good use building up devices (soldering, 3D printing, circuit design, linear debugging, working with high voltage). This month we're rolling out devices in collaboration with TFL and Hounslow Highways.

I've always taken a hands-on approach to problem-solving and iteration, lead by wanting to see and encourage change in the world.

My other skills include; Technical: electronics, robotics, soldering, workshop skills, 3D printing.

Coding: Python (2+ years), HTML, JavaScript, CSS, GitHub (2+ years), Arduino, Bela, ESP32, Raspberry Pi

Creation: Rapid prototyping, 3D modelling, ideation, design sketching/drawing