

Paul Hewett

From: Chris Boyd <chris@boyd.ee>
Sent: 17 March 2022 16:06
To: Paul Hewett
Cc: Will Wade; Gavin Henderson
Subject: Re: Current Hardware Development

Hi Paul,

New comments in green.

Tablet Back Box (NEXT PROJECT)

I've taken apart three similar products

1. Tobii Dynavox SpeechCase <https://uk.tobiidynavox.com/pages/sc-tablet>
2. PRC ChatWrap <https://www.liberator.co.uk/ipad-mini-bundle>
3. PRC Via Pro <https://www.liberator.co.uk/viapro>

Some comments on these and a few other points:

1. The Via Pro uses a small PCB to redirect the charger port. This is useful as it means user only has to charge one device and not connect two. See Via Pro Charger Adapter.JPEG.
This is a good idea, to keep costs low I would suggest one USB C on each end of the PCB, for devices that use apple's lightning connector I would suggest a short usb to lightning cable as the connectors are not available on the open market (exception of places like alibaba)

Why on each end? So the PCB could be positioned on either side of the enclosure?

My thought was that if they where at each end (iPod Power and camera) cable management might be easier, but ultimately its up to you guys to decide what placement is best.

2. The ChatWrap uses one board see ChatWrap Mini.jpeg
3. The SpeechCase uses three separate boards. See SpeechCase.JPEG and SpeechCase Main PCB.JPEG. This obviously enables them to distribute the external connections around the case.
For cost reason's I think a single PCB would be the best to target.
4. The Via Pro is using this supplier of speaker units <http://www.tb-speaker.com/products/>
Ideally we would want to find speakers that are "ported"
(example <https://www.adafruit.com/product/1669>). The example is 4 ohm, but we should also be aiming for 8 ohm as they use half the power for the same volume of sound. But any 4 or 8ohm speakers up to around 3W should work.

What do you mean ported? That it's a self-contained package you just have to plug in?

Its a speaker already contained in appropriate case for I believe back pressure when the speak is in use, usually it just makes the speaker look like its in a abs box. You could design this into the case but I'm not sure of the complexity or science behind it.

5. Gavin, our Software Engineer, is having a look at how the audio can be managed for one of our apps we will use with this on an iOS device. We'll probably need to have a remote meet to agree how this is done so we can spec the hardware side of things.
I think we should keep the channels programmable, left/right with independent volume control. This way it would work with all third party applications/products that support BLE audio. Happy to discuss.
6. We could consider for each connector on the board to have solder tags in case we want to use a remote connector in some circumstances
No problem, the only concern is space so some will have to be connector footprint (eg 3.5mm jacks SMD pads)

Yes that's fine. Like you've said elsewhere we could order a board with slightly different BOM that omits these connectors, in which case remote connectors could be soldered in their place

7. PCB size probably needs to fit within the size of an iPod Touch (<https://www.apple.com/uk/shop/buy-ipod/ipod-touch>) and not cover the camera so we design an enclosure to hold the iPod and this PCB/speaker
I don't think this will be a problem, the biggest restraint maybe the capacity of the battery and size of the speakers that will fit, we could aim for the PCB to be approximately the sizes of the iPod's display.
Regarding battery you'll want to use 1 C lithium polymer as shown in "SpeechCase.jpeg" as they are simpler from a circuit standpoint to charge safely. You can use any capacity, but will need to manually replace a resistor to set the charge rate to a safe level. (I'll provide the details of this in the design)

Was 'C' a mishit, was that 1 x lithium polymer? (When I first skim read it, I wondered if it was a particular type of battery but the speechcase one looks pretty standard)

The "C" stands for cells, the speechcase style are pretty common, if you have a 2 C lithium polymer battery you have to balance the cells to the same voltage if you don't one cell discharges into the other and has potential to cause fire. 2 cell (and up) batteries are possible but would add to the cost due to the circuitry required. You can actually get all the way up to 10Ah 1 C batteries in this style but they are difficult to source and have to travel by sea/land if purchased abroad.

8. I would really prefer that our board can plug into the iPhone to provide power so there is only the need to charge one device
See 1.
9. We need to remember why we're doing this...it's a low cost device that adds switch input and sound amplification to an off-the-shelf tablet or phone
10. Do you have a broad idea what the cost price of the electronic hardware would be? I'd be aiming for £30
Price is difficult to Judge as the main factor is volume, China is also cheaper to have electronics assembled but there are often issues around part availability and how genuine it is may be unknown. Just to give you an idea Adafruit likely manufactures the feathers in quantity's > 1000 to be able to sell their product for \$20 and make a profit. I will however keep component cost as minimal as possible.

Do you think £30 is at least the realms of possibility?

I think component and PCB wise it might be assembly will likely add to this, but I would need an idea of the likely purchasing quantity's (single order) to be able to give an estimate based on current discussions.

1. Will there be a way to change firmware, to change which character is sent to device on switch press?
Should/could we make it Arduino-compatible so that we can readily reprogrammed and set parameters.
Be interested in thoughts but do want to keep this first version as simple as possible.
There are a few options;

For the keys via an App/Over BLE

Make the charge port a serial->usb converter with a terminal to change the keys/configure settings. Could be used for Arduino, but isn't technically needed and would add a few pound to the bill of materials, Arduino/Firmware functionality could be maintained via serial to USB cable (Likely 3.3V) which are readily available.

Depending on the quantity of switch inputs, you could use dip switches to manually program the Unicode key in.

As a question, how many of the switch inputs do you think will be needed? We will likely have quite a bit of spare IO from the microcontroller but I also suggest making the inputs isolated if possible which will add to the cost for each unit.

There are normally 2 switch inputs. Should we consider using some of this IO capacity on other functionality, like some of the things on the X80 (additional switch inputs – never really need more than 5, switch outputs, IR)? I'm thinking we should keep it as simple as possible though.

Worst case we can break out some of the spare IO to a header to allow further customisation, IR is pretty simple/cheap to implement. Can I ask what its typically used for data transfer, control, or as a IR type tv remote?

X80 v5

As you know we had discussed the option of integrating a Feather nrf82540 board onto our interface so we only have a single board, removing the need to source Feather boards and solder them in place. The board would come in ready to go.

I've been chatting through this with someone who we work with. He had the idea that an alternative might be to continue to use a development board, which at the moment our board of choice is the Feather nrf82540 but use an adapter board. I've done a couple of configurations of this:

1. Feather positioned between interface <https://a360.co/3I1pbuX>
2. Stacked design <https://a360.co/3CrjEN4>

I do think this a neat idea and I think it's preferable because:

1. We can increase the volumes of our X80 board as it's used with many development boards
2. Adapter boards can be quickly created and arrive quickly
3. We're not handcuffed by out of stocks on a specific development board or IC on an integrated board if we went that way. We would be able to order higher quantities once design established.

I think the first design is likely the better from an electronics standpoint as the feathers use a common pinout you could either use 2.54mm pitch headers on the PCB (As used on Arduino etc) giving us the space under the feather. The second design could also work but would require wire to board style connection. I was thinking about a design that could a different type of development board if we wanted to, which could be something other than a feather and could be larger

The DB9 connector could be a wire to panel mount style connector to reduce the cost of an additional PCB when this is needed. (eg <https://uk.rs-online.com/web/p/d-sub-connectors/0472843>), most feathers also have LiPo support built in from what I can tell.

There are some decisions:

1. Method of connecting boards, header pins? Cables?
As above
2. Size of largest development board we're likely to use
I think most feather expansion boards are intentionally designed to be small and of similar size, if you use stackable headers you could also potentially connect multiple of these if they didn't require the same pins as used by the x80.
3. Type of connectors to use
Maybe <https://www.mouser.com/ProductDetail/Adafruit/2830?qs=xE9dPqTLfL4XzxEZXTz%252BEA%3D%3D>.

I think they make it quite chunky.

They are not too bad in person it makes 3 PCB's stacked on top of each other be around 2cm tall, so not much taller than a db9 connector.

4. Physical layout
As above
5. Final spec required.

I wonder Chris if you need any demo of kit, switch interfaces for example to see how they work. We could do a quick video of that if necessary.

This could be useful to confirm my understanding from when we met is it takes input from the switch's and passes the state to the output "patching" to the desired device. With a single latching output that works even without power. Yes that's it – I'll do a short video.

Completely up for keeping a first iteration as simple as possible but your guidance and thoughts are helpful so the first iterations you work on are as simple as possible.

I agree, this will also help with cost. I would suggest deciding on which features would be the most commonly required. Any nice to haves could also be designed in but not populated during manufacture to minimise cost. When needed you would in effect just send the manufacturer a different bill of materials. Fine

Kind Regards,

Chris Boyd

Electronics Design Engineer
BOYD.EE LIMITED (13784087)
12 Grayling Close,
Newton-Le-Willows,
Merseyside W12 9JJ
Mobile: (+44) 07577558958
Mailto: chris@boyd.ee
Web: www.boyd.ee

On Thu, 17 Mar 2022 at 10:15, Paul Hewett <phewett@acecentre.org.uk> wrote:

Hi Chris,

Just a couple of comments, inline, in red...

Paul



**Paul
Hewett**
Ace Centre

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email: phewett@acecentre.org.uk
phone: 0800 080 3115 ext 409
address: Hollinwood Business Centre, Albert Street, Oldham,
OL8 3QL



Ace Centre is a registered charity no. 1089313. Registered
Company Num: 04268143. VAT Num: 785728278.

From: Chris Boyd <chris@boyd.ee>

Sent: 14 March 2022 16:56

To: Paul Hewett <phewett@acecentre.org.uk>

Cc: Will Wade <wwade@acecentre.org.uk>; Gavin Henderson <ghenderson@acecentre.org.uk>

Subject: Re: Current Hardware Development

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Thanks for this contains a lot of useful information, see comments inline.

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Kind Regards,

Chris Boyd

Electronics Design Engineer

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Web: www.boyd.ee

On Fri, 11 Mar 2022 at 14:45, Paul Hewett <phewett@acecentre.org.uk> wrote:

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Best Regards,

Paul



**Paul
Hewett**
Ace Centre

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OL8 3QL



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Company Num: 04268143. VAT Num: 785728278.

From: Chris Boyd <chris@boyd.ee>
Sent: 09 March 2022 11:32
To: Paul Hewett <phewett@acecentre.org.uk>
Subject: Re: Current Hardware Development

Hi Paul,

No problem, there is no charge for the RelayKeys work, so far the only billable is for the 2 PCB's when I'm next on Upwork I'll put the time in for this.

Regarding availability, 2 weeks actually works perfectly for the back box, happy to discuss its requirements further.

Let me know any additional idea's/requirements you have and ill look through.

Kind Regards,

Chris Boyd

Electronics Design Engineer

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On Wed, 9 Mar 2022 at 09:33, Paul Hewett <phewett@acecentre.org.uk> wrote:

Hi Chris,

We're going to have a rethink about best to move RelayKeys forward so could you stop work on this please and put in your Upwork invoice for work you have done if you haven't already. I think you're time is going to be better spent on the hardware we'd like to move forward. If you can confirm below when you have a chance that would be great.

Thanks Chris,

Paul



**Paul
Hewett**
Ace Centre

web: acecentre.org.uk

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address: Hollinwood Business Centre, Albert Street, Oldham,
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From: Paul Hewett <phewett@acecentre.org.uk>
Sent: 08 March 2022 16:22
To: Chris Boyd <chris@boyd.ee>
Subject: Re: Current Hardware Development

Hi Chris,

We're going to proceed with the back box project. We will need to spec a couple more details which I'll email to you. Do you have an idea *roughly* when you'd fit it into your current work schedule?

It would probably be good to have a remote meet in a couple of weeks perhaps.

I've had some further thoughts on X80 v5 which is like to chat about but I'll email some more info first.

Best Regards,

Paul

Paul

Get [Outlook for iOS](#)

From: Paul Hewett <phewett@acecentre.org.uk>
Sent: Monday, February 28, 2022 3:08 pm
To: Chris Boyd
Subject: RE: Current Hardware Development

Hi Chris,

Thanks. Regarding the Handheld Switch Interface, let's go with what you've done here, that's fine.

Paul

From: Chris Boyd <chris@boyd.ee>
Sent: 25 February 2022 09:37
To: Paul Hewett <phewett@acecentre.org.uk>
Cc: Will Wade <wwade@acecentre.org.uk>; Gavin Henderson <ghenderson@acecentre.org.uk>
Subject: Re: Current Hardware Development

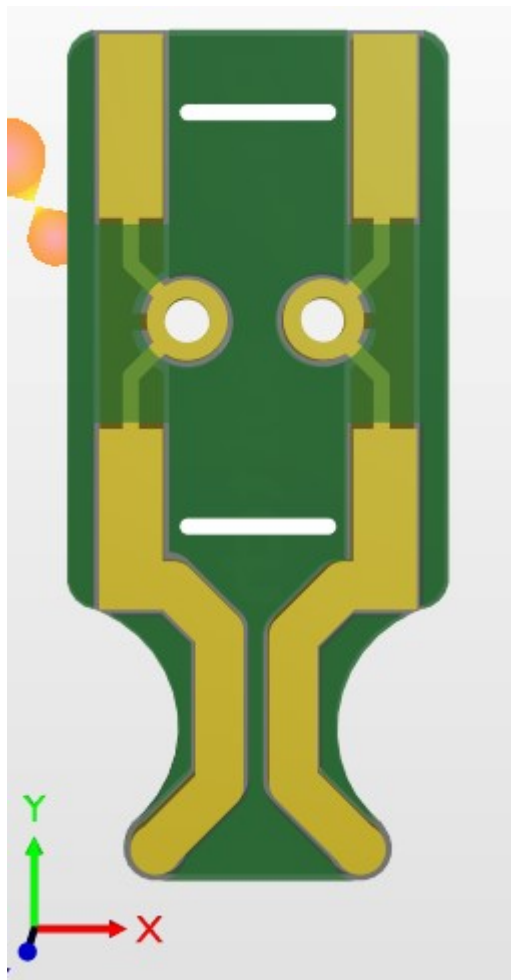
Hi Paul,

See Ring Switch PCB via google drive link, Gerber's required for manufacture can be found zipped up in the Project Outputs folder

.

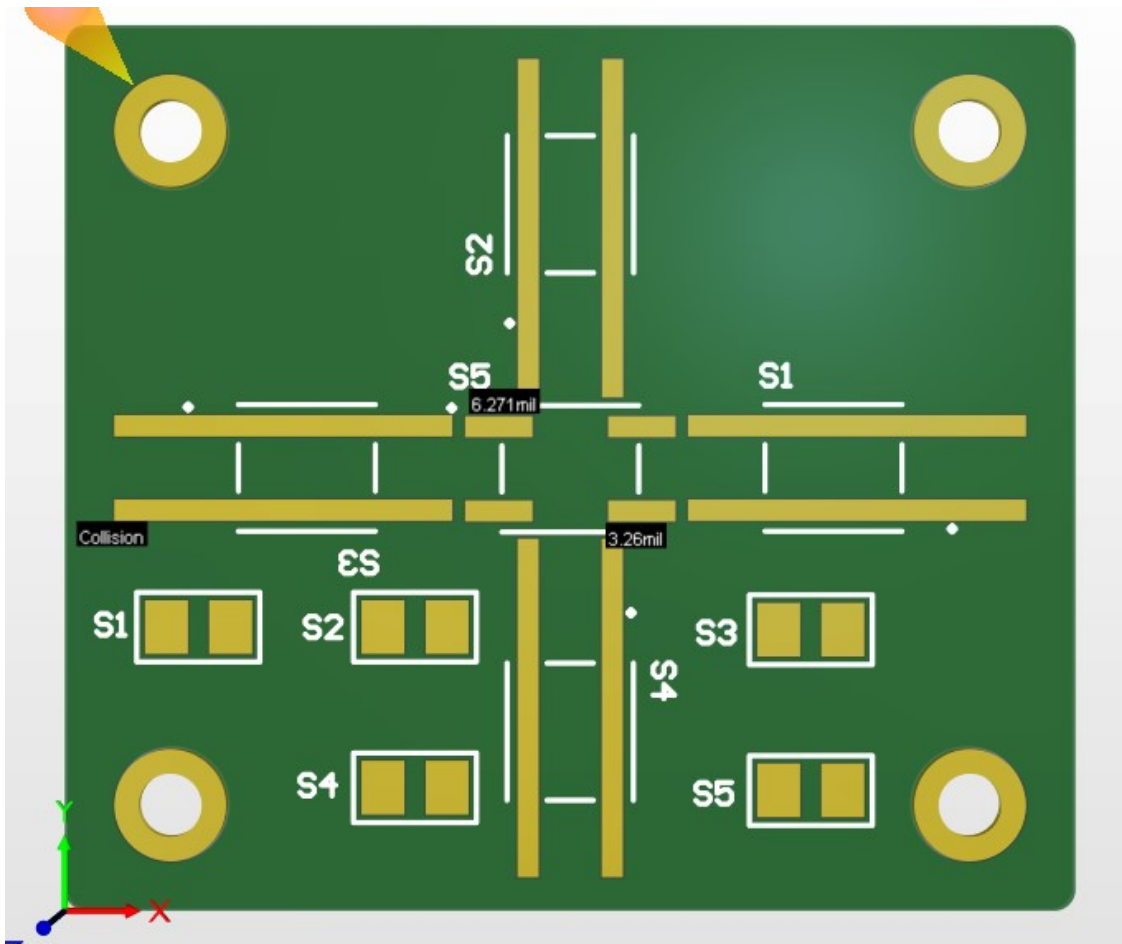


RingSwitch.zip



Attached is also a 3D PDF (Open with official acrobat reader to view), I've put the wire connections on both side to leave options open for the wiring, any issues/desired changes let me know.

Regarding the Handheld Switch Interface, the dimension of 42x48mm is to small to account for actual 3.5mm connectors we could either increase the boards outline or place them on the rear. Alternatively we could switch to wire to board something like the below which I think will give the smallest over all, or a JST stile connector?



Kind Regards,

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On Fri, 18 Feb 2022 at 10:54, Chris Boyd <chris@boyd.ee> wrote:

Hi Paul,

For the small PCB's I can fit these in quite quickly between other things, realistically you could look to be placing an order for the actual boards mid to late next week.

Via Upwork the hourly rate is 45 USD.

I can likely fit one of them in for the initial Schematic/PCB Layout with the anticipation of ordering the prototype week beginning the 7th March. The firmware/documentation side would be booked once the prototype arrives (or its arrival date is known). Its somewhat difficult to explain but I have to juggle projects to account for the down time in each project. If you where to commit to more than one they would likely be booked in a sequential manor with the Schematic/PCB Layout of the next being scheduled to start after the order was placed for the first an so on.

Re: Keyboard to Voice

Its worth investigating the idea of off loading the text to speech to the cloud. My only concerns would be that this would limit its use to places with Wi-Fi/Internet, and there may be issues with lag in certain places/counties. It may be worth implementing the hardware based text to speech as a back up if the Internet becomes/is unavailable, but this would add to the complexity of the board.

Re: Generic Tablet Back Box (Bluetooth Version)

2 audio channels are no issue, the way I see it is an ESP32(or similar) connected to 2x I2S DAC's with each then connected to a speaker via appropriate amplifier/driver circuits we can divert one of the channels with independent volume control when a headphone jack is plugged in much like how it works on a phone/tablet but in this case only on a single channel. The device would appear as a Bluetooth Speaker to the tablet or other device, we can also flip the left and right channel in firmware meaning that if other app's use the audio channels

differently the back box could still be used. It might even be worth adding a switch to allow this to be user configurable.

Kind Regards,

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On Thu, 17 Feb 2022 at 15:03, Paul Hewett <phewett@acecentre.org.uk> wrote:

Hi Chris,

That's really helpful, thanks. I've just noted a couple of immediate comments below. Perhaps just check if they affect anything from your point of view and drop an email back if they do.

A couple of points:

- I'm going to proceed with the 2x small PCBs. When would schedule those in? I can do the dxf this week.
- Could you also just confirm the hourly rate, particularly for the larger projects?
- How would you fit these in with other work?

Thanks Chris, look forward to any other comments if you have them.

Best Regards,

Paul



**Paul
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From: Chris Boyd <chris@boyd.ee>
Sent: 17 February 2022 12:44
To: Paul Hewett <phewett@acecentre.org.uk>
Cc: Will Wade <wwade@acecentre.org.uk>
Subject: Re: Current Hardware Development

Hi Paul/Will,

Many of the proposed projects are of similar complexity. I've based the estimates on the information provided and each being the first project. As we can reuse parts of at least the schematic from one to the next speeding up the other projects (eg battery circuitry). For information where I give a time in days this is a multiple of 8hrs.

Regarding CircuitPy this is defiantly an option, it looks like there are existing libraries for the functionality required. It may take more time to convert any existing firmware, but I'm also more than willing to fix issues in the libraries if needed.

- X80 Firmware Updates
This would be best done along side the Hardware V5 revisions. - Fine
- Ring Switch PCB (just need PCB design to send to PCBWay or similar for a batch)
Approx. 1-2 hours assuming a DXF of the PCB dimensions is available?
Queries;
1. Do you want the connection for the 3.5 jack to be SMD style so the PCB will sit flush? On the PCB just switch no jack. Cable soldered onto pads on PCB. I'll send dxf.

- Handheld Switch Interface (just need PCB design to send to PCBWay or similar for a batch)
Approx. 2-3 hours
Queries;
 1. Are the 4/5 switches to be connected via 3.5mm Jacks and is this via wire to board or via connector? I'd like you do design the board for 3.5mm jack sockets (been using RS 124-8885 but we can alternatively not solder in place jack and wire to board instead. This gives some flexibility for enclosure which is useful at this stage)
 2. Do you intend to assembly these by hand, I ask for the elongated pads idea? Yes. The elongated idea was so we could space the switches closer or further apart depending on user
 3. For the elongated pads how much give do you hope to achieve, and is it only in one direction? 6mm adjustment for each one (except centre)
 4. Can the 5th switch be in a fixed central location? Yes
 5. Do you have preferred mounting hardware eg M3? Yes, prefer M3
 6. Do you want the connection for the 3.5 jack to be SMD style so the PCB will sit flush if not using connectors? Yes
- X80 Hardware v5
 If you just want the JST fixed and Gerber's generated Approx. 1hr, Don't think it's worth doing this. Assuming we look to integrate the feather as discussed when we met and add in some of the nice to haves Approx. 2-5 days for base firmware (very much dependant on Nice to haves), 4-5 days for Schematic Capture/PCB Layout, 3 days for base documentation, then approx. 0.5-2days per example/firmware with documentation depending on complexity. Fine. The only nice-to-have which would be really nice to have would be this <https://github.com/gdsports/usbmseble>
 Queries;
 1. Would the Potentiometers be best on a header to allow it to be mounted elsewhere? I don't think that's necessary unless you give us some benefit, eg space on board
 2. Would you consider a smaller connector eg USB Type C and using a adapter if required? Type C probably better in this day and age, fine
 3. What type of display would be preferred? Display is a nice-to-have (and it would stay on my nice-to-have list at this point I think). I'm open to offers on this one depending on space/cost/complexity for programming etc
- Generic Tablet Back Box
 I'll need more time to evaluate this project as it will have to function as a composite device via Bluetooth which would add to the complexity of the firmware for the nice to haves, I do think Bluetooth would be the best solution though. OK.

A wired version using USB hid for the inputs and a 3.5mm jack for the audio, would take Approx. 2 days for Firmware, 4 days for Schematic Capture/PCB Layout, 2 days for documentation. Let's evaluate the BT version and decide, but would tend to agree with you in that BT is the best option. Would prefer keeping the first iteration as simple as we can initially. We have had a recent discussion that a similar type of box would be great to pair with a device like an iPod touch for people that use our Pasco app (see <https://acecentre.org.uk/resources/pasco>). This actually needs to use two audio 'channels', one to output speech to the communication partner and one to give an audible cue (perhaps via single ear headphone which could be wired to our 'box'). AN idea has been to use Left and Right channels differently. This is sometimes a useful feature and we need to discuss how it links with software – but is sometimes useful on other bigger devices. Basically we could do with chatting about this further.

Just as a bit of a disclaimer we can make it so that it can use reclaimed speakers, but the quality of the sound is heavily dependant on the construction/design of the case. Sure

Queries;

1. Are you able to handle the mechanical design aspects? Yes
2. Does this need to interface with the Second Screen Voice Output? Would be great if it could, but would be a nice-to-have

- **Make HID Bluetooth**
Approx. 3 days for Firmware, 4 days for Schematic Capture/PCB Layout, 2 days for documentation.
Queries;
1. Do you have preferred dimensions? In my head this is about 40x40x10mm to also accommodate a battery
2. Would it be advantageous to have a switch to allow the end user to switch the device between a HID Mouse/Keyboard/Gamepad rather than rely on changing firmware? That would be fine
3. I'm assuming this is to be battery powered? Yes it would need to be
- **Keyboard to Voice**
Approx. 3 day for Firmware, 5 days for Schematic Capture/PCB Layout, 2 days for documentation.
Assuming
the on market text to speech synthesis IC's are suitable (eg Epson ICs S1V30120) which will need verified (prototyped) prior to the Schematic Capture/PCB Layout . It would be good to hear the quality of speech – bit difficult to confirm on YouTube – seem like a couple of different versions. We could assume the device is on a wifi network so could use a server-based service for speech generation.
Queries;
1. Does the display need to be anything fancy or would a character display suffice (Note screen type can influence how long it takes to write the firmware)? I think we need to decide if this needs to be as simple as possible (with a simple screen you plug the keyboard into) or whether alternatives using a mobile device might be better with a companion app – so done in software rather than hardware.
2. Does this need to interface with the Second Screen Voice Output? Would be great if it could, but a nice-to-have.

A couple of links Will's forwarded re. speech:

<https://www.acapela-group.com/solutions/acapela-tts-for-linux-embedded/>

<https://www.nuance.com/index.html>

Kind Regards,

Chris Boyd

Electronics Design Engineer

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On Wed, 16 Feb 2022 at 11:34, Paul Hewett <phewett@acecentre.org.uk> wrote:

Hi Chris,

I've added some images to the Tablet Back Box showing the current configuration in one of the commercial products that might be useful.

Paul



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From: Paul Hewett
Sent: 14 February 2022 19:50
To: Chris Boyd <chris@boyd.ee>
Cc: Will Wade <wwade@acecentre.org.uk>; Gavin Henderson <ghenderson@acecentre.org.uk>
Subject: Current Hardware Development

Hi Chris,

Good to catch up with you today. Our current hardware to-do projects are listed here:

<https://gist.github.com/paulhewett/5808dd81123875c2328941e9263cf141>

A couple of those are being completed elsewhere by a supplier or I'll do them. The ones that I'd like you to review to get an idea of time and therefore cost are:

- X80 Firmware Updates *see below
- Ring Switch PCB (just need PCB design to send to PCBWay or similar for a batch)
- Handheld Switch Interface (just need PCB design to send to PCBWay or similar for a batch)
- X80 Hardware v5
- Generic Tablet Back Box
- Make HID Bluetooth
- Keyboard to Voice

The top item X80 Firmware Updates are detailed here:

<https://gist.github.com/paulhewett/9d78fb5857f73d0ed29d53636523b364>

You're already working on RelayKeys. Movement Switch will be done by Celtic Magic as this is based on their G-Click (<https://www.celticmagic.org/g-click>)

Essentially we want to migrate a number of bits of firmware listed here onto our X80 board (<https://github.com/AceCentre/X80>) and specifically X80 Standard (<https://github.com/AceCentre/X80/tree/main/hardware/X80%20Standard>). Another electronics engineer developed the designs for these and there is an error with the power daughter board (<https://github.com/AceCentre/X80/tree/main/hardware/X80%20Power>) in that the jst connector for the LIPO battery has been specified in reverse so the board tends to smoke! We can get round this by hardwiring the battery without soldering on the JST in the correct polarity. In particular, in priority order:

1. MorAce
2. X80 Example Code (so we have a consistently structured code with correct use of example for use of buzzer, standard tones etc)
3. Switch Switcher Wired
4. Switch Interface Wired
5. Switch Interface Bluetooth
6. Blink Switch
7. Two Switch Mode Interface (might be useful to review this sooner to have an understanding for other firmware using Bluetooth)

Broad outline time and cost will be fine initially and then this can be refined once we decide which ones to develop and when.

Call me if you need any more details or if it anything doesn't make sense.

Best Regards,

Paul