Wio Link For SVH

GNG 2101 - Deliverable C.1

Submitted by Team E24

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Date: September 24th 2020

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Functional Decomposition

Core functionality:
The main goal of the system is to be a user interface that is easy to use and program. Meaning that someone with little coding experience will be able to understand and use it. Moreover, it must be able to accommodate multiple sensors (Touch sensor, voice sensor etc).

Sub-functions:
Depending on the user input, the program must be able to execute several basic commands. These commands are determined by the user's input, varying from how they want to interact with their environment or if they require a nurse and need to call them.

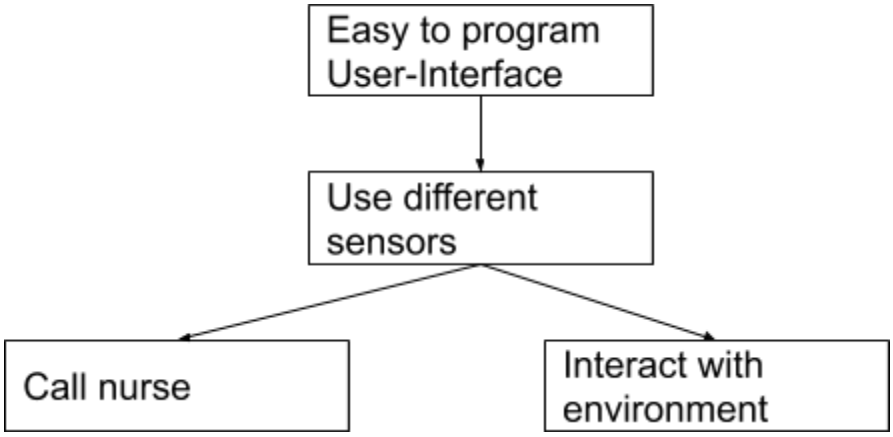

Figure 1: Functional decomposition (see *Appendix)*

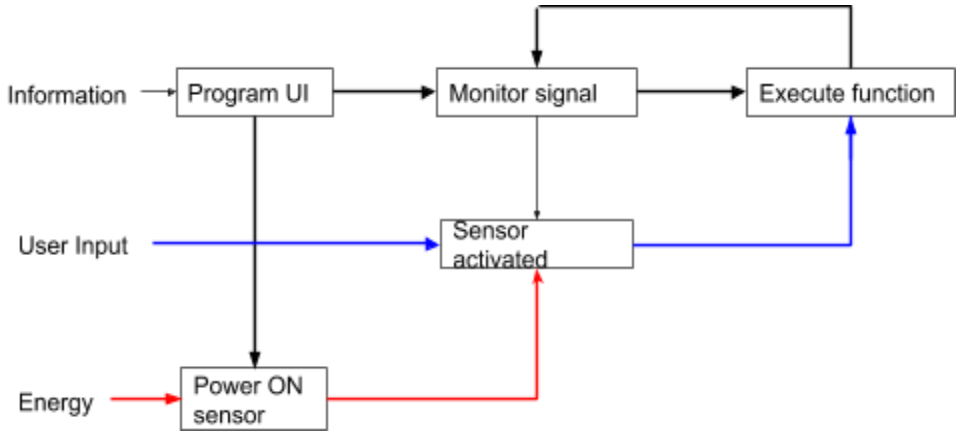

Figure 2: Detailed functional decomposition (see *Appendix)*

Concepts

David C1: Basic user interface
The nurse simply inputs what type of sensor/device and the program runs. It is the patient who manages what option they want to use (call nurse, turn on TV etc) and use the sensor to navigate through each sett

David C2: Ipad application
The patient is given an ipad with an app (programmed by the team) that has all the different options one would need (Call nurse, TV setting, Browse wifi etc) and with the WIO link and a sensor, the individual can navigate through the application.

David C3: Type to application
After launching the app, a prompt shows up on the screen asking what type of device the patient is using. The nurse then types into the computer the type of accessibility. Shortly after, a Pop-up asks the nurse what the patient would like to do (television, internet etc)

Jack C1: An interface controlled by facial expressions
The user interface has two main functions, those being, call nurse and television control. With this in mind, using a set of facial expressions, hospital patients will be able to control both of these things. However to avoid any problems with occasional accidental adjustments, the expressions will have to be exaggerated.

a) Call nurse - Show teeth
b) TV on/off - Tongue out
c) Volume up - Close right eye and hold until desired volume
d) Volume down - Close left eye and hold until desired volume
e) Channel Up - Raise right eyebrow
f) Channel Down - Raise left eyebrow

With this concept, there is minimal effort from nurses to set up each individual interface.

Jack C2: A system of pulleys and bells
In order to alert nurses of any issues there will be a pulley attached to a bell that can be rung for assistance. Additionally, the other pulleys will be attached to other devices such as the television controls.

Jack C3: Interactive helmet
Using a helmet that follows the movements of a patient, the user will be able to interact with their environment using a handful of simple movements and by pressing switches on the helmet.

Gavin C1: UI for medical Staff
A node red menu allows nurses to choose one of a variety of preset inputs (eye tracker, touch sensor, etc) in a visually appealing, block coding like menu and match it to a given output by dragging the blocks together. This way if a patient is only capable of moving their finger, the touch sensor can then be used to control the tv, then be switched to contact the nurse.

Gavin C2: UI for Patient
Two different physical UI's are created for the patient. The patient will have a combination of sensors depending on that patient that can be touch sensor/eye sensor, touch sensor/voice sensor, touch sensor/motion sensor. This preset will be determined by the medical staff based on the patients needs. They are then given the ability to cycle through preset outputs (tv control, call nurse, read e-book, etc) on their own. The system would work by having them choose an output by hitting the touch sensor a defined number of times (IE 2 hits means call nurse function is primed, 3 for e-book, etc) then they use the second sensor to navigate the subsystem. For example,

Button Press 1 Chooses TV→ eye sensor: looks left means change channel up, look left means channel down, look up means volume up, look down means volume down.

Then each output would have defined controls for each input.

Gavin C3: Pitch Sensor For TV Control
A patient uses the pitch of their voice to control a desired output → high means increase channel, low means decrease channel

Philippe C1: Node-RED UI
This is a tool or file to be used within the Node-RED coding software. It allows Nurses to create applications for their patients. Essentially all the nurse has to do is link different pre-programmed functions together to create applications to best suit patient needs. An example of this is that a Nurse could link a motion sensor signal received from a Wio link to a call nurse button.

Philippe C2: Touchpad

A touchpad that allows patients to navigate accessible menus. These menus would include options to communicate with hospital staff and interact with everyday devices.

Philippe C3: Arrows

4 Arrow buttons to navigate menus that include options to communicate with hospital staff.

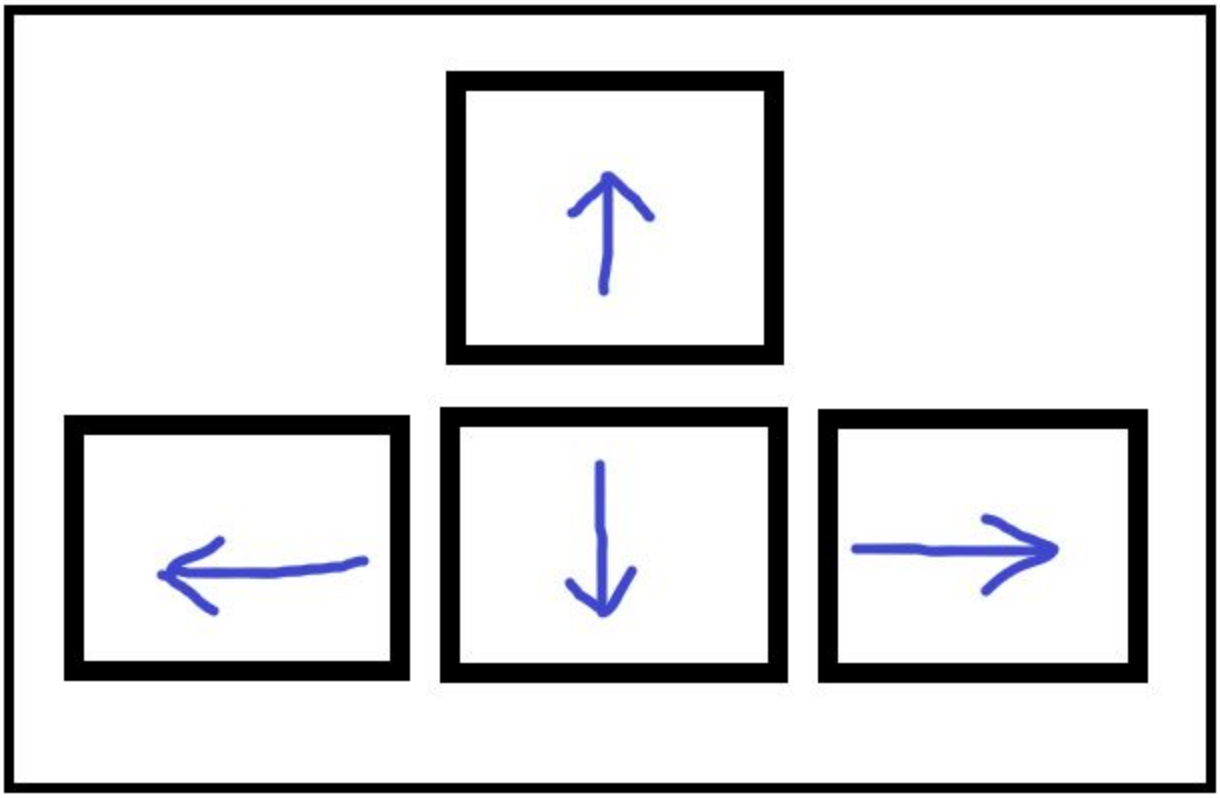

Figure 3: Sketch of Philippes's C3 concepts; Arrow navigation (see *Appendix)*

Kaleigh C1: Simple navigation
To improve ease of use as well as compatibility with a wide range of accessibility devices, navigating menus could be done using only two inputs. Input one could be "next" and input two could be "select"

Kaleigh C2: Eye-Tracking
Patient simply looks at different spots on the screen depending on what function they want the software to perform. Different functions can be represented by different icons in case the patient is unable to read

Kaleigh C3: Software controlled by voice
The software can be voice-controlled for patients who are blind. The patients would simply have to tell the software which function they want performed. Can be activated by a voice command similar to a google or alexa assistant (ie. “okay google”) and the patients can tell the software to call the nurse.

Clément C1: Movement detector (Accelerometer)
Ball or small object that can be hold in the palm of your hand that detects movements like translation rotation and the intensity of these movements that will be translated into input for the given device

Clément C2: Movement detector (motion sensor)
Camera paired with a motion sensor that can be translated into inputs for given device (like a simplified Myo)
Clément C3: Nunchuck
Simple remote with 1 thumb joystick and two buttons to navigate through menus and options

Concept Evaluation

Concept options										
Target specification	Weight	David			Jack			Gavin		
		C1	C2	C3	C1	C2	C3	C1	C2	C3
Cost	0.1	10	1	10	7	5	3	10	5	5
Connection to wifi	0.07	10	10	10	10	1	7	10	10	1
Connection to Bluetooth	0.07	10	10	10	10	1	7	10	10	1
Ease of Use (Patient)	0.2	4	7	10	3	3	3	7	4	4
Ease of Use (Nurse)	0.2	10	10	3	10	5	6	8	10	10
Aesthetics	0.05	3	7	2	2	1	2	5	5	4

Customizability	0.1	2	1	1	7	1	10	10	6	3
Instil Confidence	0.1	5	8	3	4	3	6	6	6	5
External materials	0.01	10	10	10	5	1	1	10	10	5
Device Compatibility	0.1	10	5	10	1	1	2	10	10	1
Score		7.15	6.75	6.60	6.05	2.80	4.99	8.35	7.25	4.59

Table 1: Weighted solution evaluation table for concepts by David, Clément and Jack

Concept options										
Target specification	Weight	Philippe			Kaleigh			Clément		
		C1	C2	C3	C1	C2	C3	C1	C2	C3
Cost	0.1	10	1	5	10	3	4	2	1	3
Connection to wifi	0.07	10	10	1	10	1	1	1	10	5
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Instil Confidence	0.1	6	8	8	8	5	6	6	6	9
External materials	0.01	10	10	4	4	5	5	4	1	2
Device Compatibility	0.1	10	5	1	1	1	1	1	1	1
Score		8.35	6.75	5.56	6.09	5.27	4.94	3.48	4.31	5.57

Table 2: Weighted solution evaluation table for concepts by Philippe, Kaleigh and Gavin

Score Calculation:
Each target specification is given a decimal value (percentage) called the weight. The sum of all the weights is equal to 100% . Some specifications' weights are far superior to others because of their importance. For example ease of use on the patient's and the nurses end is worth 40%, while external materials is only worth 1%. Each concept is evaluated by how well it meets the target specification, it is given a criteria value of 1-10. Where 10 means it is the optimal solution for the criteria and 1 meaning it doesn't meet the criteria.

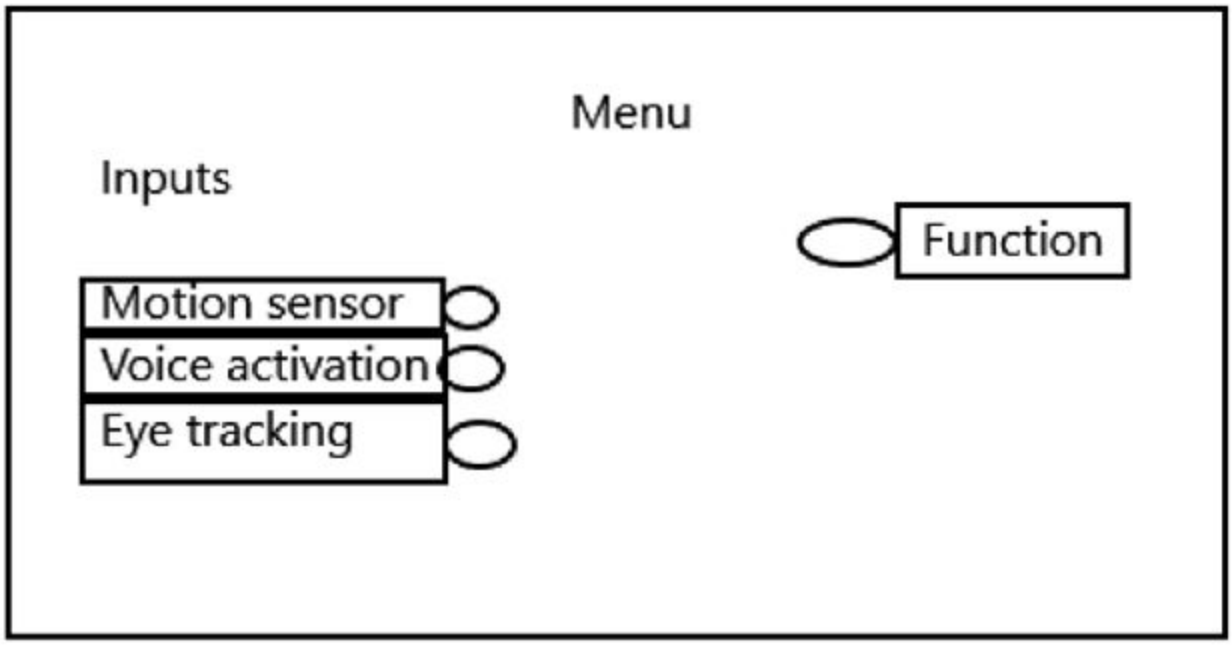
The score is then calculated by multiplying the weight by the criteria value. The final score is the sum of all the specifications. The higher the score the better.

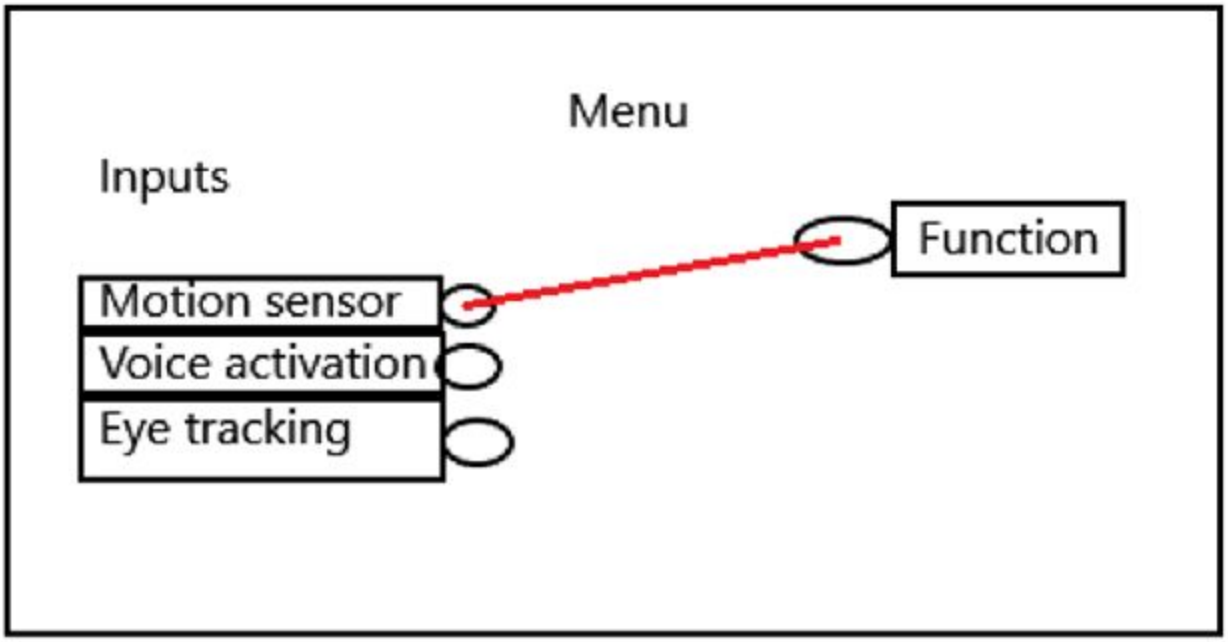
Final Concept

The concept scoring the highest score was a tie between Phil C1 and Gavin C1. They were essentially the same idea. Not only did they meet the specifications (highest score), they also used the software that the client suggested: Node-RED.

Final concept explained.
The final concept will not change very much from the original suggested concepts. This is because they easily meet the requirements of the client and solve the problem statement.

The concept uses the Node-RED software, the nurse will "program" the interface depending on the user's needs. The programming section will be simple and easy to understand. The nurse simply has to link preset inputs (eye tracker, touch sensor, etc) in a visually appealing puzzle like menu and match it to a given output by dragging the blocks together.





Analysis

This concept is chosen over other concepts due to its ease of use. First it was important to understand that during a shift, the nurse has to cover lots of patients and doesn't always have time to spare. That's why it was very important to make the solution as easy to operate as possible. The “puzzle block” coding requires no coding experience and should not give a nurse any difficulty. Moreover, given its high score

in the evaluation section, the concept meets all the target specifications. However, the concept is not without flaws. Take the scenario where the patient decides that they do no longer want to watch tv and want to listen to the radio or something. The nurse will have to manually deselect the television function and then select the radio function. This issue is not only an inconvenience for the nurse but the patient as well. A few logistics issues will need to be finetuned.