



CREATIONS de UiTM
INTERNATIONAL MEGA INNOVATION CARNIVAL **2023**
Fostering Innovation to Global Communities

LET'S CRAFT A BETTER WORLD TOMORROW!

ePROCEEDING

20th MAY 2023

UNIVERSITI TEKNOLOGI MARA
CAWANGAN SELANGOR, KAMPUS DENGKIL
MALAYSIA

ORGANISED BY:



UNIVERSITI
TEKNOLOGI
MARA

Pusat
Asasi



Beethoven Light Improve Image Quality by Complying to Breathing Instruction for Patient with Hearing Impairment in Cardiac MRI

***Nik Nur Qahirah Yahya, Majalda Jaafar, Rupaida Binajul, Richie Encabo Rigi, Zarif Nukman Rohaizat**

Radiology Department, Hospital Al-Sultan Abdullah UiTM, Selangor, Malaysia

*E-mail: qahirah@uitm.edu.my

ABSTRACT

Cardiac magnetic resonance imaging (CMR) is a medium to diagnose a wide range of heart conditions by using magnetic resonance imaging (MRI). To be able to perform the procedure; effective communication on breathing instruction is crucial in every CMR patient including those who have hearing challenges and language barrier. The patient needs to comply with the repetitive breathing instruction respectively. Failure to do so will lead to the verge of production of poor image quality of heart that has no diagnostic value and the physician having trouble diagnosing the patient's condition even worse leading to fatality and mortality. Hence, this is where Beethoven Light comes into a picture to overcome this problem. It is designed to be such a portable device and convenient handling that consist of only 2 colors of light: red and green. The Beethoven Light successfully could aid the patient with its simple instruction for those who cannot comply and bare breathing instruction especially patients that have hearing disability, elderly, and also communication and language barrier.

Keywords: CMR; MRI; Beethoven Light; magnetic resonance imaging; hearing challenge

INTRODUCTION

The cruciality of effective communication is obvious in any discipline of business including healthcare itself. Countless negative impact rooting from poor communication such as misdiagnose, wrong treatment and procedure, increase duration of procedure, delay essential treatment and even worse death of patients [8]. Cardiac MRI is one of the procedures in any healthcare centres that face this difficulty on a day-to-day basis whereby some patients having trouble due to cannot comply with breathing instructions as poor communication happens.

Cardiac MRI is an examination that evaluates the function and structure of the heart using an MRI machine ranging from congenital and acquired heart diseases, including cardiac masses, myocardial ischemia or infarction, coronary artery disease. However, the nature of the heart itself, respiratory motion and systolic ventricular blood complicate cardiac imaging [2]. It is because we need to gain an optimal image despite the sensitivity of MRI machine towards motion as these motions can cause artifact; a feature appears in an image that is not present in the original object and may be confused with pathology and some affecting quality image. Hence, to overcome these problems, MRI becomes a demanding examination. Multiple breath-hold instructions will be given and last for a long examination time [1].

Although the multiple breath-hold instruction is simple and repetitively; deaf patients, elderly and foreigners found it difficult to understand and comply with instruction. Such situation makes them contraindicated for MRI as they are unable to stay still and obey instruction and the image produced will be suboptimal, restrict the interpretation, decrease the

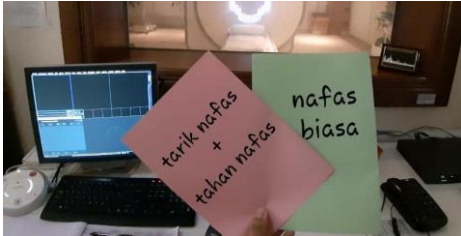
accuracy of report [4] and in some cases if cannot be helped the case will be abandoned and re-appoint. Moreover, there are many articles that depict the gap of communication between these groups of patients with healthcare professionals. For example, incidents of the largest cluster of COVID-19 in Singapore the radiographers meet difficulties to perform Chest X-ray as the patient which is foreign workers native language is not English. The rejection rate in their hospital shows a dramatic increment of rejection. Second, an article by Yahya Y. Akeely,2022 “Communication Challenges While Dealing with A Deaf Patient in the Emergency Department and Suggested Solutions” showed that in the emergency department, they are having difficulties when dealing with deaf patients.

Beethoven Light

Thus, with Beethoven Light it acted as visual communication to overcome this problem. Visual communication is found to have great significance. It also could communicate with great speed and simplicity as it can access the whole world regardless of level of literacy or language origin [6]. One study in 2013 showed that doctors and patients interpreted data from medical test results more accurately when the information was presented visually, rather than numerically [3]. Taking road safety as an example, road users mostly obtain information visually. Because of the color, patients can clearly differentiate the natural forms [6]. In Beethoven Light: red means hold breath while green means breathe in. Plus, it is globally accepted that green means go, and red means stop [5] making it available to the whole world.

INNOVATION DEVELOPMENT

Before the innovation idea happened; we used two pieces of color paper to guide the patient for breathing instruction. It is quite a hassle as we need extra help from others to be inside the MRI examination room to repetitively show the color paper based on the instruction given to the patient. The product shown as below;



Our innovation development began with a complaint letter from Consultant Cardiologist (who interpreted the cardiac MRI image for patient diagnosis) regarding poor image quality due to breathing instruction incompliance in Cardiac MRI. The letter shown below.



Due to the complaint letter above, a team known as “Beethoven Project” is created to find a solution for this problem. It consists of staff from both Radiology and Cardiology Department UiTM which work hand in hand during cardiac MRI procedure. After various brainstorming during our meeting session, Beethoven Light had come to light. Its main goals are to improve image quality and breathing instruction compliance in Cardiac MRI. Apart from that, Beethoven Light is proven to reduce the procedure time to be as comparable with normal patients for patients with hearing difficulty. Subsequently, it helps to reduce wastage of MRI consumables items if patients cannot obey the instructions like wastage of contrast media which cost more than RM 100 per case.

The Beethoven Project had proposed two prototypes to solve the problem regarding the incompliance on breathing instruction.

	SUGGESTION 1	SUGGESTION 2
DRAFT		
PROS	<ul style="list-style-type: none"> • Portable 	<ul style="list-style-type: none"> • Portable • Lightweight • Small in size and can be place at the shelf in front of MRI screen. • Easy to use with light switch
CONS	<ul style="list-style-type: none"> • Cannot be used inside MRI room because the wires (copper) can interfere with the MRI signal inside the MRI room which lead too degraded image quality. • Some parts of the prototype used metal which can be attracted to MRI machine. 	

Figure 1: Comparison between 2 model

After weighing up the pros and cons, Model 2 is chosen

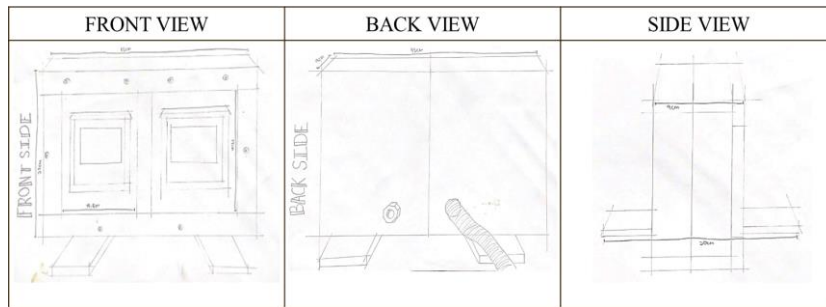


Figure 2: Preliminary Project Sketch

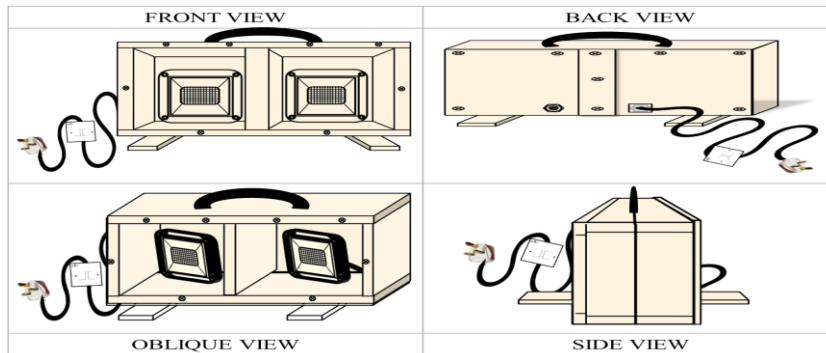


Figure 3: 3D Model Prototype

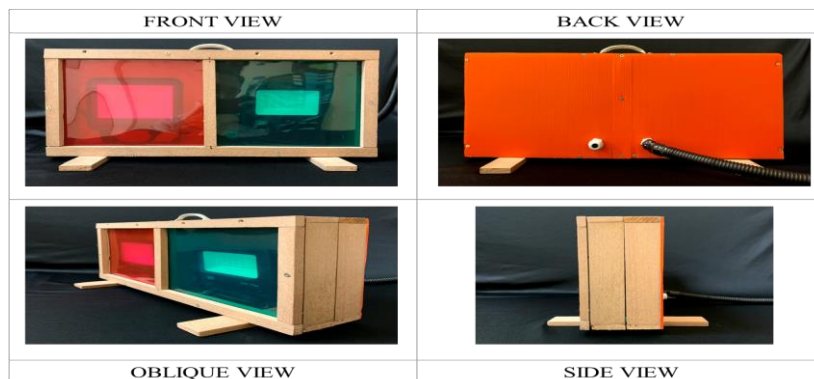


Figure 4: Actual Prototype

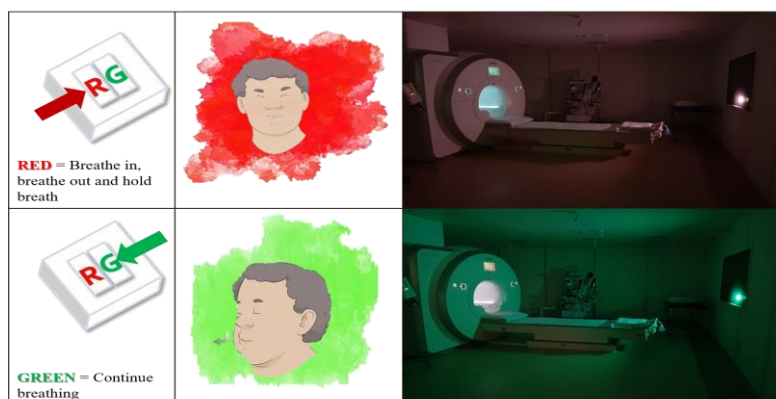


Figure 5: Demonstration of operational instruction

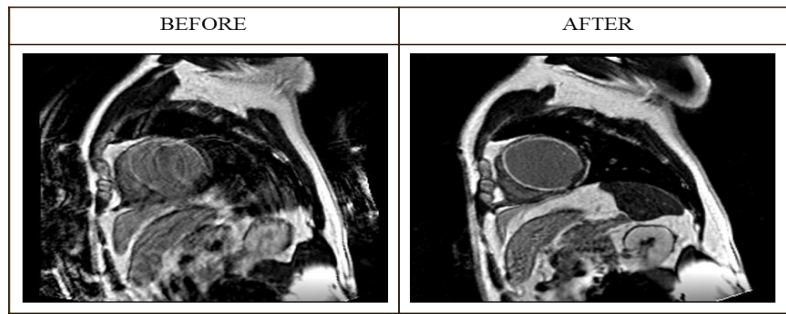


Figure 6: Post contrast cardiac MRI image before and after using Beethoven Light

COMMERCIAL POTENTIAL

Beethoven Light is capable of revolutionizing the healthcare market especially as it has the ability to make healthcare accessible to all. Like traffic lights it can be distributed globally. Our target market right now is the Radiology Department across Malaysia. We had received feedback from other colleagues in other healthcare centres and it was profound. We believe that it can cross globally as each healthcare centre usually has a Radiology Department. Our product is not limited to MRI only, it can be used in all modalities that require breathing instruction. (CT, X-ray). This can make healthcare organizations become more feasible for any type of patient.

Our sales strategy with local hospitals first, and partnership to upgrade with any partnership.

Table 1: List of prototype production material and price

NO	ITEM	QUANTITY	UNIT PRICE	TOTAL
1	PVC insulated cable blue 1.5mm	10	RM1.50 per meter	RM15.00
2	PVC insulated cable red 1.5mm	10	RM1.50 per meter	RM15.00
3	PVC nut box surface (3inch x 3inch)	1	RM0.50	RM0.50
4	PVC insulation tape	1	RM0.50	RM0.50
5	Flexible conduit wire loom sleeve	10	RM1.00 per meter	RM10.00
6	13A 3 pin plug top socket (SIRIM)	1	RM4.50	RM4.50
7	2 gang 1 way switch (SIRIM) 1	1	RM12.00	RM12.00
8	Osram Ledvance LED 20W Floodlight	2	RM30.00	RM60.00
9	Ceiling spin wood	10	RM1.50 per feet	RM15.00
10	Screws	1	Rm2.00 per packet	RM2.00
11	Nails	1	RM0.50 per packet	RM0.50
12	Handle drawer	1	RM0.50 per packet	RM0.50
13	PP corrugated board	1	RM6.00	RM6.00
14	A4 plastic folder file (red)	1	RM3.90	RM3.90
15	A4 plastic folder file (green)	1	RM3.90	RM3.90
TOTAL				RM149.30

Our prototype cost is fully funded by the team members. Our team member, Mohamad Faizal Samsuni had built this product based on our sketch and 3D model prototype. Below shows the total cost of our prototype production.

- MATERIAL COST + LABOR COST + MISCELLANEOUS (UTILITY & TRANSPORTATION) = RM149.30 + RM54.72 + RM4.00**
TOTAL COST = RM208.02

- <https://www.ajronline.org/doi/pdf/10.2214/AJR.10.7231> (Accessed: May 5, 2023).
- [3] Gaudiano, P. (2015) *As it turns out, a picture is not worth a thousand words*, *Wired*. Conde Nast. Available at: <https://www.wired.com/insights/2014/03/turns-picture-worth-thousand-words/> (Accessed: May 6, 2023).
- [4] Maryam ghadami (2022) *National Center for Biotechnology Information*. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK551669/> (Accessed: May 6, 2023).
- [5] Samaniego, J. (2020) *Traffic signs don't depend on language – or do they?*, *Ferrovial*. Ferrovial. Available at: <https://blog.ferrovial.com/en/2019/07/traffic-signs-dont-depend-on-language-or-do-they/#:~:text=Red%2C%20yellow%2C%20green,red%20is%20a%20mandatory%20stop> . (Accessed: May 6, 2023).
- [6] Singh, A. A., Hwang, S. J., Chang, S. C., & White, B. (2017). Affirmative counselling with trans/gender-variant people of color. In A. Singh & L. M. Dickey (Eds.), *Affirmative counselling and psychological practice with transgender and gender nonconforming clients* (pp. 41–68). <https://doi.org/10.1037/14957-003>.
- [7] Treutlein, C. *et al.* (2019) *Complete free-breathing adenosine stress cardiac MRI using compressed sensing and motion correction: Comparison of functional parameters, perfusion, and late enhancement with the standard breath-holding examination*, *Radiology. Cardiothoracic imaging*. U.S. National Library of Medicine. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7977924/> (Accessed: May 6, 2023).
- [8] The hipaa journal (2022) *Effects of poor communication in Healthcare*, *HIPAA Journal*. Available at: <https://www.hipaajournal.com/effects-of-poor-communication-in-healthcare/> (Accessed: May 6, 2023).