Currency Identification Assistant For Visually Impaired

Nabill bin Hidzir Pauzi, Shahrul Azam Abdullah[*]
Faculty of Mechanical Engineering, Universiti Teknologi MARA,
40450 Shah Alam, Selangor, Malaysia

[*]shahrulazamabdullah@gmail.com

ABSTRACT

As a rapidly developing country, Malaysians in general enjoy technologically advanced services and facilities. However, disabled people such as visually impaired group may face barriers to conduct basic activities because. One of a very difficult task for a person with visual impairment is to identify and differentiate Malaysian Ringgit notes from each other. Therefore, a device is needed to accommodate the need of this group. This paper will focus on development of a device to address the abovementioned issue. The main objective of the project was to build a prototype handheld device that will be able to differentiate Malaysian notes and recognize it accurately. The design is developed using a computer-aided design software; CATIA V5R20 and the conceptual design were visualized using three-dimensional printer. The devices are designed to be at low cost to fabricate allowing them can be owned by the visually impaired people without any hassle.

1.0 Introduction

As one of the progressing country towards technological advance service and facilities, every community in Malaysia should experience the advancement equally. Yet, handicapped people, especially visually impaired community still facing difficulties in their daily life and one of it is a transaction where they are facing problems with is to differentiate Malaysian currency notes. This lead those visually impaired to be vulnerable to the trickery threat in common society. In Malaysia, approximately 0.325% of the population were blind or partially blind. Pusat Pembangunan Orang Buta Malaysia (PPOBM) has registered 50,000 people with the condition and it is believed that 50,000 more have yet to register.

Visually impaired person must fully depend on their sensation to go through their daily life. Money transaction is one of the crucial activities where the visual impaired must identify the currency notes. Design for currency identification device can help a visually impaired person to identify the Malaysian ringgit currency notes. The objective of the paper is to generate and sketch a new currency identifier for visually impaired which is modular and easy to use and fabricate the notes identifier for prototype using high strength material. The design will focus on notes identifier to distinguish differences between notes based on size. RM50 and RM100 can be differentiate according to their width as compared to other notes. RM1, RM5,

RM10 and RM20 could be identified based on their length. This device is small and easy to carry around without having to carry a bag.

Notes identifier is an innovating design based on brainstorming and discussion. The design will be in 3-dimensional performed using CATIA V5R20 software with tolerance of ±1 mm. Multiple sketches are generated and the best one have been chosen. For notes will be focus on latest generation(4th generation) of Malaysian ringgit. The notes are RM1, RM5, RM10, RM20, RM50 and RM100. The maximum dimension for notes is RM100 with 151mm length and 68 mm width. Notes identifier will be maximum dimension of 80 mm length, 10 mm width and 70mm height. These dimensions is for easy storage and high portability, the design will be small and easy to use

2.0 Visual Impairment

Visual impairment is a loss sightedness disability that cannot be corrected with glasses or contact lenses. This can be caused by factors, including abnormalities in the development of the eye or injury to eye structures from things like prematurity-related retinopathy or infections or by developmental problems or injury to the parts of the brain responsible for vision. [1]

Table 1: Major type of blindness [2]

Blindness Type	Information	Global Percentage (%)	Symptom	Causes	Treatment
Cataracts	Protein builds up in the lens of your eye, making it cloudy	47.80	Cloudy and Blurred central vision	Aging (>50)	Surgery
Glaucoma	Disease that affects the optic nerve of the eye	12.30	Black spot and worsen over time	Elevated Eye Pressure	Surgery in early stage
Age-related Macular Degeneration	Macula function as central vision affected	8.70	Central vision loss. Sensitive to light and blurred	Aging (>60)	Reduced with diet and medication
Diabetic retinopathy	Blood vessels of the eyes is blocked	4.80	Vision loss and blindness	Diabetes	Reduction with laser treatment

Focusing with four highest percentage causes to visual impairment as shown in the Table 1, most of the majority causes can be treated or reduced but the spending on such treatment will be expensive. Lower percentage causes are likely untreatable because the condition is more severe.

Visual impairment community is very vulnerable to fraud. Culprits take advantage of this community especially during a transaction where they cannot argue with the seller if the being accused paying a wrong currency. Some country uses braille on their currency but this is not very effective especially for the bank notes. Globally, a country with notes as their main currency type having a similar problem where the braille on notes easily wore off because of the material used. Another problem faced by the community is the time taken to identify and storing the currency during the transaction. They should identify one by one. In some country, such as Malaysia, the visual impairment community facing a confusion because of the similar sizes between notes and coins. For example, RM20 and RM50 notes have a relatively similar length.

Without any tools or devices to assist the visual impairment person, they use the technique that is taught to them to identify the currency. For example, the technique used in the United State of America (USA) is measuring the US Dollar notes with their fingers and for storage, they will have a different type of folding for each note [3]. For Malaysian, they identify the easiest notes (RM1 and RM5) and use the identified notes to identify other notes by comparing. Malaysian stored by stacking the notes in order from small to biggest value and memorize the quantity of the notes in their wallet when comes to storage. For coins, they identify by touching the side of the coins for some countries including Malaysia. Unlike other country, Japan made their coins in a convenient manner fora visual impairment person to identify. Every coin in Japan is made with different sizes and indicators. For storage, the easiest way they use is having a wallet or bags with plenty of pockets and stored different coins in different pockets.

There are numbers of disadvantages with current solution to identify currency. The visual impairment community should feel one by one the coin or notes before storing. There are some people facing with very similar size for the currency inflict confusion and there are limited or none effort to create a wallet specially for visual impairment.

There are some of the existing devices to assist visually impairment, for example, the coin sorter with electrical voice assistant can cost plenty for most people to afford and it is usually coming in large sizes. Next, electrical notes identifier has a lot of advantages but it is only limited to some advanced countries such as USA and Canada. Other than that, there is an application created in smartphones to identify currency using camera identification. The application is only developed in advanced countries such as Japan and USA.

3.0 Malaysian Currency Dimension and Characteristics

From Table 2, note that RM20 and RM50 have only a slight difference in dimension which allow confusion for visually impairment person. There is braille sign imprint for each of the notes but will wear off after number of usage or transaction.

Table 2: 4th Generation Bank Notes Dimension and Characteristic

Ringgit	L × W (mm)	Material Sensation	Braille sign	Braille location	Notes Color
1	120 x 65	Slippery/Plastic	——	Bottom Left Conner	Blue
5	135 x 65	Slippery/Plastic				Green
10	140 x 64	Dry paper	=		Red
20	146 x 65	Dry Paper					Orange
50	145 x 68	Dry Paper	* *	Top left Conner	Dark Green
100	151 x 68	Dry Paper					Bottom Left Conner	Purple

4.0 Note Identifier

The simple note's identifier shown in Fig. 1- 3 could help visually challenged person to identify all Malaysian Currency. There will be an indicator for specific Malaysian Note placed on rear and top of the design. In this design, Malaysian notes need to be placed on the front side and hold in the pocket provided. Then, the note is folded to the rear until it touches the specific indicator.
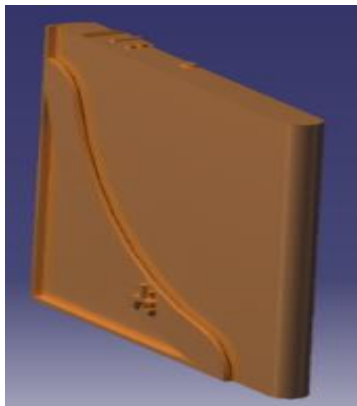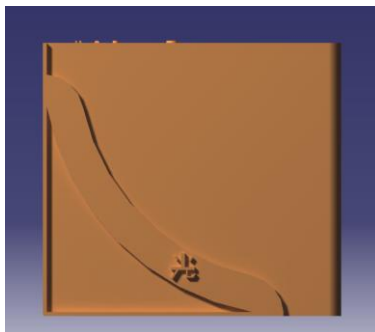

Figure 1: Isometric view for Note's
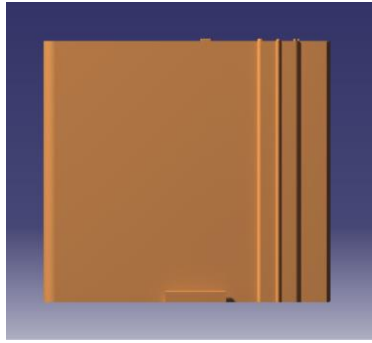

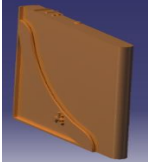Figure 2: Front View of the Note's Identifier

Figure 3: Rear View of the Note's Identifier

Table 3 shows comparison between designs of the note's identifier with existing product.

New note's Identifier	Existing Product
o Identify bank notes for Malaysian Ringgit. o Using folding method to identify its measurement based on length and width. o This new design using ABS plastic which is higher strength than cardboard. o Raised pattern to identify bank notes.	• Using folding method but can only identify based on measurement of the note's length. • Using cardboard. • Raised pattern to identify bank notes.

5.0 Analysis

Material

The material used is Acrylonitrile Butadiene Styrene (ABS) plastic. The advantages for this material includes high durability, long term usage, and using less heat to shape. Table 4 shows the properties of ABS plastic.

Table 4: Properties of ABS Plastic

	Properties	Value
Physical Properties	Density	1030 kg/m^3
Mechanical Properties	Tensile Strength (Ultimate)	40 MPa
	Tensile Strength (Yield)	41.37 MPa
	Modulus of Elasticity	1.4 - 3.1 GPa
	Poisson's Ratio	0.35
	Shear Modulus	2068.43 MPa

The design is aimed to be affordable, easy to fabricate and light elements. This is for visually impaired person convenient. The material is suitable for portability and eases to bring. There will be a minimal load on note's identifier so it will not exceed maximum force when using properly. The properties of notes identifier are shown in Table 5.

Table 5: Properties of ABS Plastic

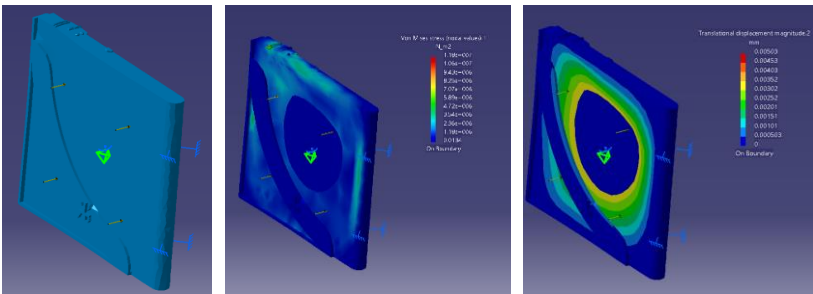| Properties	Value
Volume	1.34×10^{-5} m^3
Area	0.015 m^2
Mass	0.016 kg
Density	1050 kg/m^3

Structural and Stress Analysis

Figure 4: Analysis on Note's Identifier for deformation, Von Mises Stress and Translational displacement (Left to right)

By using CATIA analysis as shown in fig. 4.20, it is determined that it is only suitable for note's identifier because the design targeted for cramped storage such as trousers' pocket or wallet so the analysis is done when using it and compression while stored in a tight place. With 200N expected force while holding and storage, the design produced good results in both ways. There is several notice able less strength spots as shown in the figure above but will not affect much for durability. The deformation as shown in the figure above shows the finite element mesh under 200N load. The outcome is very good with minimum changes. For von mises stress, the maximum stress value is 1.18E7 N.m^2 also indicates the design can withstand the force given. Finally, the translation displacement with a maximum value of 0.0053mm.

6.0 Final Product

Figure 5: Prototype of the note's identifier.

Figure 6: Demonstration on how the prototype hold the notes.

Figure 7: Rear side on the note's identifier and raised pattern.

Figure 5 shows the note's identifier printed using 3-dimensional printer. The printer manage to produce even the smallest details of the design. Demonstration is shown on how to hold and read the notes. In figure 6, there are slot to place the note and cutout to hold the note in place using finger. Figure 7 shows the rear side of the note's identifier. The raised pattern can be seen to read every type of Malaysian notes. For this demonstration, the identifier shows the correct reading for RM20.

7.0 Conclusion

From the studies of the visual impairment community, it is identified that they are facing difficulty during currency transactions. There is a lot of steps to achieve for the prototype fabrication to overcome their problem. Steps from identifying the problem faced by them until the final step of fabrication. The information gained from studies, discussion, survey, and interview is carefully studied on how the device should be created. A framework is created for guidance to achieve every objective to overcome the problem by this community. Every flow is followed thoroughly to achieve every demand and objective. Finally, it is fulfilled indicates that the project is successful. There are a lot of brainstorming to create the design and PUGH method is used to choose the best design. The design is developed in the CATIA V5R20 software and further analyzed for improvement before fabricating the test model. The design for note's identifier allows user to understand its mechanism easily in a short period. Although the material is ABS plastic, the

analysis shows that the material is very suitable to aim for low budget devices with high endurance. The material is chosen for this project making it easier when supply the devices to visual impairment community.

Acknowledgement

8.0 References

[1]   D. Gordon (2010). "Visual Impairment in Children due to Damage to the Brain". Mac Keith Press

[2]   Silvio P. M. (2012). "Global Data on Visual Impairment 2010". World Health Organization, 6.

[3]   Jeevandeep P. (2015). "A new light On Blindness. Treasure of Life". 7, 29-39.

[4]   R. Suskind (2010). "A Hope in the Unseen: An American Odyssey from the Inner City to the Ivy League". Random House, Inc.

[5]   Strickling C. (2010). "Impact of Visual Impairment on Development." Texas, USA Texas School for the Blind and Visually Impaired.

[6]   O. Osagie (2013). "Blinded by Sight: Seeing Race Through the Eyes of the Blind". Stanford University Press.

[7]   F. Margaret (2014). "Who was Louis Braille". Penguin Group.

[8]   Duker Jay S. (2008). "Ophthalmology", 3rd ed. Edinburgh: Mosby.

[9]   Spungin S.J. (2003). "Free and Appropriate Public Education and the Personnel Crisis for Students with Visual Impairments and Blindness". Center on Personnel Studies in Special Education.

[10]   Al-Wayel A., Al-Mutairi S. (2005). "Registered blindness and low vision in Kuwait". Ophthalmic epidemiology.

[11]   Reddy S. C. (2004). "Prevalance and Causes of Visual Impairment and Blindness in a Rural Population in Sepang District, Selangor". Med J Malaysia, 59(2), 212–217.

[12]   Gregor P., Newell A.F., Zajicek M. (2002). "Designing for Dynamic Diversity – interfaces for older people". Proceedings of the fifth international ACM conference on Assistive technologies. Edinburgh, Scotland.

[13]   Sadato N. (2005). "How the blind "see" Braille: lessons from functional magnetic resonance imaging". The Neuroscientist: A Review Journal Bringing Neurobiology, Neurology and Psychiatry, 11(6), 577–582.

[14]   Hermann D. (1999). "Polly and Nella. Hellen Keller: A Life". 1(20), 275-278.

[15]   Christine Roman-Lantzy (2007). Cortical Visual Impairment: An Approach to Assessment and Intervention. New York: AFB Press.

[16] Dutton G.N., Jacobson L.K. (2001). "Cerebral visual impairment in children". Seminars in neonatology: SN.

[17] Pesudovs K., Tan D. (January 2011). "The impact of cataract surgery on quality of life". Current Opinion in Ophthalmology.

[18] Dardzhikova A.A. (January 2011). "Consequences of waiting for cataract surgery". Current Opinion in Ophthalmology.

[19] Wang S, Wang J.J., Wong T.Y. (2008). "Alcohol and eye diseases". Surv. Ophthalmol.

[20] Nazatul Naquiah Abd Hamid, Wan Adilah Wan AdnanFariza Hanis Abdul Razak (2017). "Identifying Sound Cues of the Outdoor Environment by Blind People to Represent Landmarks on Audio-tactile Maps". © Springer International Publishing AG