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Technology Transfer and Training on Making Adaptive Sticks to Instructors at SLBN-A Citeureup, Cimahi City to Improve the Mobility Orientation Ability of Students with Visual Disabilities

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ABSTRACT

All students and teachers with Visual Sensory Disabilities (PDSN) in the State Special School Category A (SLBN-A) Citeureup Cimahi City have been equipped with basic Mobility Orientation (OM) technical skills to be able to carry out independent activities and mobility. The OM technique uses five still-functioning senses: a white cane and a guide. Another problem from the assistant's side was that both class and dormitory teachers felt worried/anxious regarding PDSN students' whereabouts in the school environment. PKM's output for making sticks is focused on ergonomics, ease of installation, use, and functions that do not burden the PDSN. The stick will detect objects before you and inform you about them through sound (beep), vibration, or a combination. In implementing this PKM, the team carried out knowledge and technology transfer to the Instructors/Teachers as well as testing to the PDSN. This activity results in an electronic walking stick that has been tested.

Keywords*: disability, cane, mobility*

1. INTRODUCTION

Referring to several PKM results from educators, other research, and the World Health Organization (WHO) regarding walking sticks for PDSN. The stick is part of the identity (referring to the community's social conditions) of the PDSN, which is still valid today and is the standard for independent activities. **(Bimantoro, 2014);(Kamila, 2019);(Afni, 2021);(Dwiana, 2023).**

PDSN with permanent/blind or low vision categories can carry out social functions in the form of activities and mobility in society without the help of assistive devices or sighted companions. However, if this condition is forced, there is a risk to the safety of the PDSN. Paying attention to safety factors, all PDSN students in the SLBN-A environment (located on Jl. Sukarasa No. 40, Citeureup, North Cimahi, Cimahi City) are equipped with OM technical skills by the DIKNAS curriculum starting from Kindergarten (TK), class 1 to 12. The practice of OM with a sighted assistant is taught for kindergarten and grades 1 to 6, while the use of standard cane aids is taught from grades 7 to 12. Table 1 shows data on the number of students in SLBN Citeureup, Cimahi City, in 2023 with category A (Visual Disabilities), as many as 39 out of a total of 186 people for five categories.

Table 1. Statistics of Academic Year 2022/2023 of SLBN-A Citeureup Cimahi City Students

NO	SATUAN PENDIDIKAN/KELAS	JUMLAH SISWA DAN JENIS KELAINAN									JML
		A	B	C	C1	D	D1	E	ADHD	AUTIS	
	TK										
1	TKLB	1	1	1							3
JUMLAH TKLB		1	1	1	0	0	0	0	0	0	3
2	SDLB										
	1	2	2	7			4			2	17
	2		1	5			3			4	13
	3	2	2	9			3				16
	4	1	3	4	3		2				13
	5	6	3	2	6		1			1	19
	6	3		8					1	1	13
JUMLAH SDLB		14	11	35	9	0	13	0	1	8	91
3	SMPLB										
	7	5	2	5	5	1	2			1	21
	8	3	1	4	3					1	12
	9	3		10			2				15
JUMLAH SMPLB		11	3	19	8	1	4	0	0	2	48
4	SMALB										
	10	7	3	9							19
	11	1	5	5		1	1			1	14
	12	5	3	2			1				11
JUMLAH SMALB		13	11	16	0	1	2	0	0	1	44
TOTAL		39	26	71	17	2	19	0	1	11	186

Figure 1 shows the forcing activity of PDSN without tools (reluctance and making things easy because they feel memorized complicated, there is no novelty or more benefits). PDSN maximizes the five senses of touch that are still functioning, hands, feet, and body to find out whether the path is flat or has obstacles in front of it, so the object must touch the five senses. Activities along pedestrian paths/roads and recognizing objects with this technique are at risk of collisions, injuries, health, cleanliness, safety, limited distance, and inability to determine the direction of the clock (compass, making it difficult to return to your destination).

Figure 1. PDSN Forces Activities Without Assistive Equipment

Figure 2 shows the forcing activities of PDSN to carry out activities using the help of teacher assistants with special needs. This was done because of the reluctance and simplistic attitude of PDSN students who felt they had memorized the track. It was complicated; there was no novelty or benefit, so they needed clarification about returning to class after taking a break from studying in the canteen. With this concept, PDSN will find it difficult to be independent. Apart from that, PDSN activities along pedestrian paths and recognizing objects with the help of teacher assistants with special needs each make it possible to get lost because they need help to determine the direction of the clock (compass, making it difficult to return to their destination). Embedding features have carried out several cane developments for blind people to assist with mobility. **(Aulia, 2020);(Yuwono, 2020);(Syaifurrahman, 2020);(Faruk, 2017),** other developments using cameras and ultrasonics as electronic sensing **(Pramadhana, 2022);(Nugroho, 2011);(Mardhotillah & Yesputra, 2021).**

Figure 2. PDSN Activities Using Teacher Assistants with Special Needs

Figure 3 shows that the guiding block route for PDSN still does not have standard directions for national or international systems (going/returning, or there is only one yellow line). This guiding block path concept allows PDSN to collide first before avoiding (even if using assistive devices.

Figure 3. PDSN is active in the International National Standard Guiding Block Path at SLBN-A Citeureup, Cimahi City

Figure 4 shows that the path for PDSN activities is the same as for ordinary people (without guiding block paths). This condition is not much different from Figure 3 and Figure 1, which require a stick or five sense aids to touch the object. Activities along the road and recognizing objects with this technique are at risk of collisions, injuries, health, cleanliness, safety, limited distance, and inability to determine the direction of the clock (compass, making it difficult to return to your destination).

Figure 4. PDSN Forces Activities on Routes Without Guiding Blocks

From the problem in Figure 1 to Figure 4 it is proposed that the stick will detect objects in front and inform them through sound (beep), vibration, or a combination of both to make it easier for People with Visual Sensory Disabilities to walk.

2. METHOD

The method for implementing PKM activities offered from the observations and analysis of problems faced by SLBN-A Citeureup Cimahi City partners is divided into 2: theoretical and practical assistance. The theory of scientific transfer takes the form of training in design technology (using 3D printing) and electronics related to sensors and actuators (LiDar, buzzer, DC motor). The technological and scientific results received are put into practice to become a prototype of an adaptive electronic stick. The tested prototype results will be used as a blueprint document for development or increasing quantities independently by partners in Figure 5. This is a schematic diagram of the electronic hardware design of the electronic and control system for the Adaptive Stick.

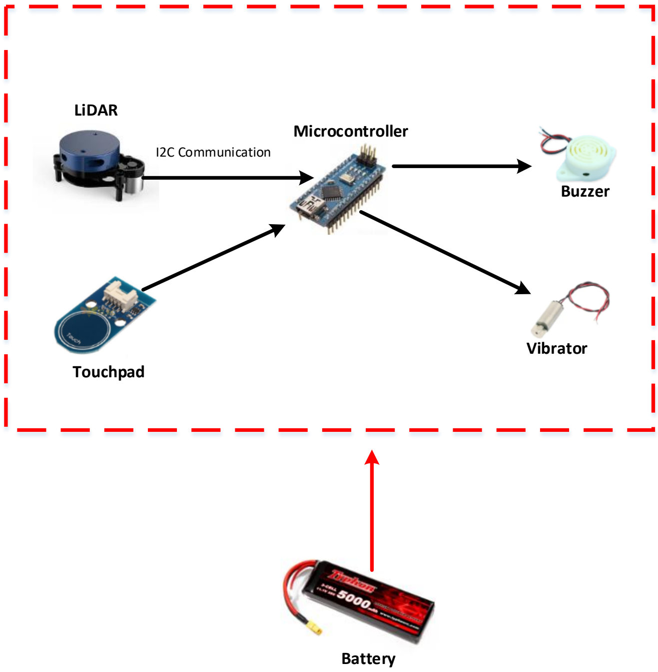

Figure 5. Adaptive Stick Electronic Control Hardware Diagram

Figure 5 is a diagram of adaptive stick control where on the stick, LiDAR functions as sensing, and the buzzer as a marker/notification. Then, the microcontroller is the main control center. The overall circuit details for the electronic control system can be seen in Figure 6.

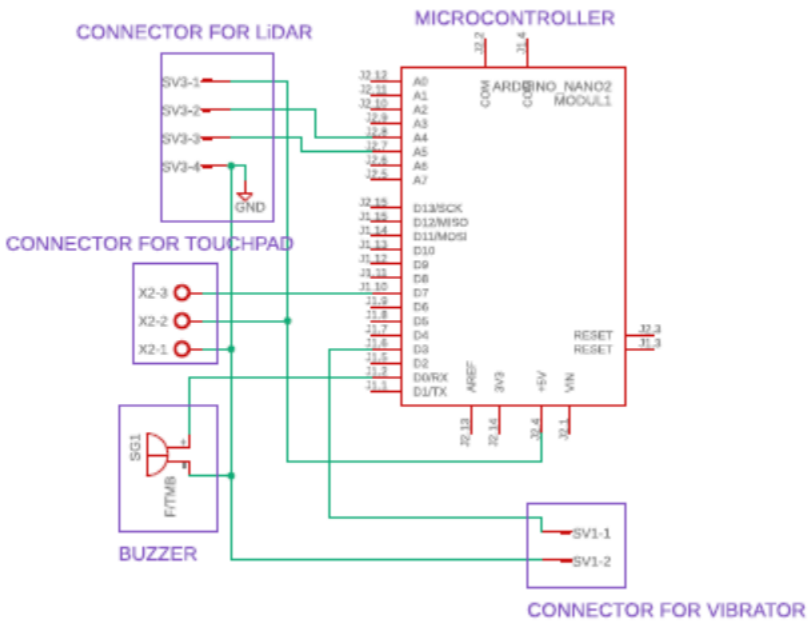

Figure 6. Schematic of Adaptive Stick Control

Figure 6 is the entire control module system in the form of an Arduino nano microcontroller as the central control, with connectors consisting of a connector for the touchpad, a connector for LiDAR, and a connector for the vibrator motor. Table 1 explains the use of input and output (I/O) on the microcontroller.

Tabel 2. Input and Output on Microcontrollers

No.	Pin Arduino NANO	Function	Description
1.	A4 & A5	Input	SCL & SDA
2.	D7	Input	For Touchpad
3.	D0	Output	For Buzzer
4.	D3	Output	For Vibrator

Table 2 is a table of I/O on the microcontroller from the series Figure 6. Data communication system from LiDAR in the form of I2C (SCL and SDA), Touchpad, and for notifications/markers using a buzzer and vibrator.

2.1 Training Participant Selection Process and Number of Participants

This stage is carried out to anticipate interest that exceeds the capacity of training participants. Apart from that, to more effectively provide material during training and test practical results in the form of a prototype of an adaptive electronic walking stick. The PKM Team management conducted this selection process in collaboration with SLBN-A Citeureup partner Cimahi City. Participants who will be selected consist of standard physical staff and staff with special needs, as well as students from grades 7 to 12 PDSN. In fact, in the field, the selection process is simple because those who will be trained are those who are used to being tasked with OM learning and maintaining computer equipment for PDSN activities related to braille book printing and libraries. The staff involved will be ten people, including the head of the Skills Center, a Productive Visual Teacher, a Visual Teacher as PDSN, and three students as PDSN). The background of the staff who will be trained consists of Bachelor's and Master's degrees. Meanwhile, PDSN students are taken from the results of grades 7 to 12.

2.2 Creation of Training Materials

At this stage, training modules are created for theoretical and practical training to produce prototypes of adaptive electronic walking sticks. This includes creating a practical guide on sensors and actuators that partners can use. The material that will be created is adapted to the results of the last site visit, discussion, and interview in July. The material to be transferred includes:

1. Design the case in the Fusion 360 software application
2. Analog electronics
3. Microcontroller applications
4. Sensors, transducers and actuators
5. Introduction to buzzer actuators and DC motors
6. System integration and adaptive electronic wand troubleshooting

2.3 Implementation of Assistance, Training, Manufacturing and Testing of Adaptive Electronic Stick Prototypes

The implementation of assistance in making prototypes of adaptive electronic sticks was carried out in conjunction with training in 3D printing design, actuator transducer sensors, electronics, microcontroller programming, and operation and maintenance. Before integrating electronic components into the PCB, each training participant is given basic knowledge of sensor transducer actuator and data processing problems through training described above. After being given the material mentioned above, the training participants were then given training material about:

1. Identify the problems faced as described above;
2. Then, it also explains the analysis of the problem and the solutions provided, along with other technical reasons;
3. Carry out work together on integrating electronic components (LiDar, buzzer, DC motor, microcontroller) on the PCB, then store in a 3D printing casing and integrate with WHO standard sticks;
4. After completing integration into the PCB and integration with the WHO standard stick, technical testing is carried out by special needs staff and PDSN students to determine whether the results will be as expected or not. If there are still problems, solutions will be sought again based on conditions in the field.
5. Created SOP documentation for using prototypes and a blueprint for making prototypes of adaptive electronic wands and equipped with instructions on operating, setting up, and practical troubleshooting if there are problems.

3. RESULTS AND DISCUSSION

The results of the realization of the tool in the form of an Adaptive electronic wand are shown in Figure 5. in the form of a (prototype/prototype of the tool) that has been tested/feasibility study document.

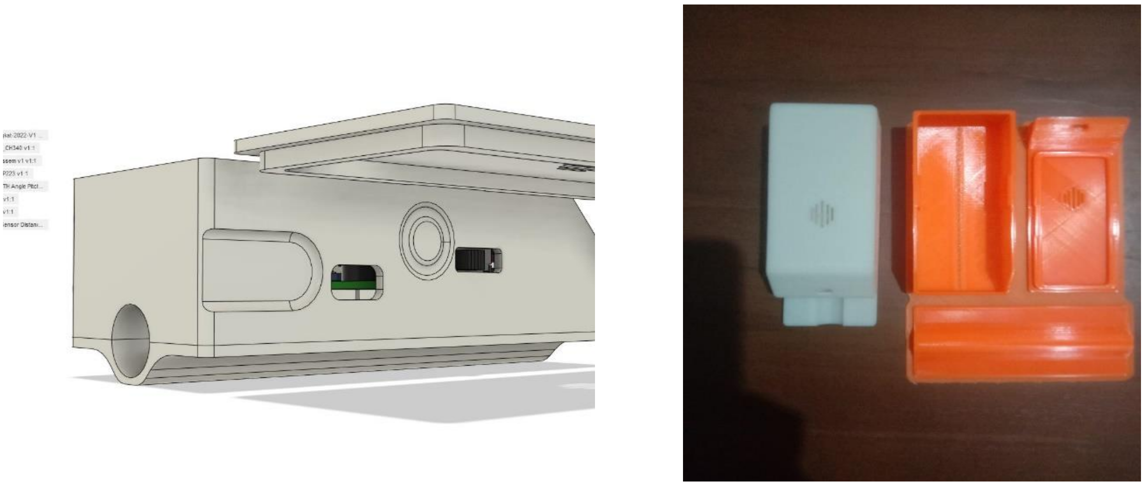

Figure 7. Adaptive Electronic Stick Product Prototype

Figure 7 is the result of the casing design for the Adaptive electronic stick product prototype, which is equipped with sensors such as Lidar, and GPS for obstacle detection, and a headset jack is available to listen to sound notifications when there is an obstacle in front of it—figure 6 results from implementing an electronic cane used on people with disabilities.

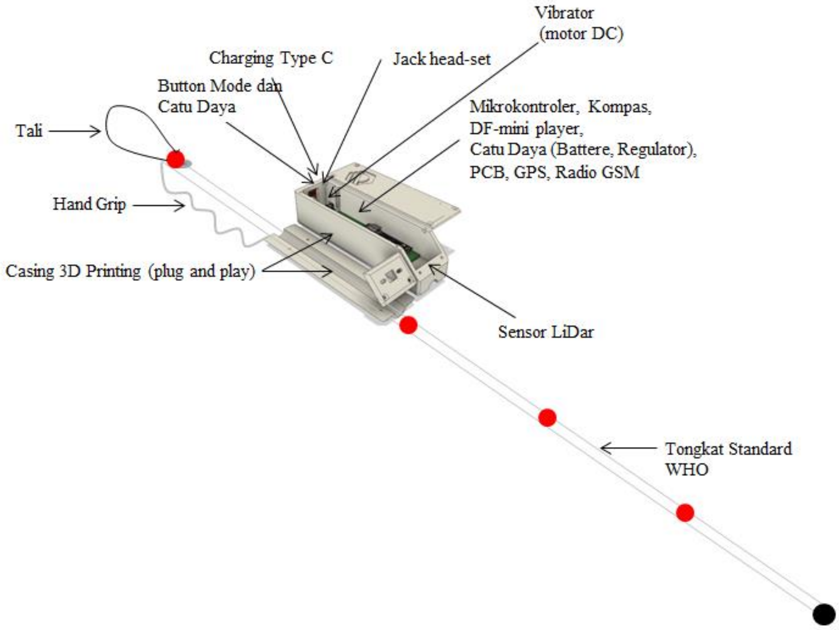

Figure 8. Adaptive Electronic Stick Product Prototype

Figure 8 shows the resulting product of the Adaptive electronic stick. Training for theoretical and practical class activities is carried out at Partner locations. Partners play a role in providing training venues with samples of Adaptive electronic sticks.

Figure 9. Adaptive Electronic Stick Training

Figure 9 is documentation regarding training in operation and maintenance for the Adaptive electronic wand. The trainees who will participate in teaching in this training consist of teaching staff who already have competence in their respective fields and who can support this activity.

Based on the opinions we received from users, namely instructors and students, this adaptive stick is very helpful in activities for the visually disabilities. With this adaptive stick, students with visual disabilities can find out the surrounding conditions when carrying out activities. As for the instructors, they hope that this stick can be further refined, including by making better packaging and that in the future it can be commercialized.

4. CONCLUSIONS

Transfer of technology and training in making adaptive sticks to instructors at SLBN-A Citeureup, Cimahi City, for all students and teachers with Visual Sensory Disabilities (PDSN) in the State Special School environment category A (SLBN-A) Citeureup, Cimahi City who are equipped with Mobility Orientation technical skills has been implemented well and successfully. Adaptive sticks can be used by students and teachers with Visual Sensory Disabilities with ergonomics. These ease of installation, use, and functions do not burden the PDSN with a stick feature that can detect objects in front and inform about them in sound (beep), vibration, or combination. The next step that will be taken as a continuing effort to develop this adaptive stick is to improve its design and construction to make it easier to use. Apart from that, in further development, sound output will be implemented through headset speakers so that users can know more information about the surrounding environment.

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