ISOEVA-2022

6th INTERNATIONAL SYMPOSIUM OF EDUCATION AND VALUES

(6. ULUSLARARASI EĞİTİM VE DEĞERLER SEMPOZYUMU)

27-30 Ekim/October 2022

Kemer/ANTALYA

TAM METİN KİTABI

(FULL TEXT BOOK)

ISBN: 978-605-73901-6-5

KORİNT YAYINCILIK

DESIGN OF SMART SIGHTLESS CANE (SSC)

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ABSTRACT

The technology has grown broadly along with time and generations on rebuilding existing products to boost its functionality, in which the visually impaired community too received benefits from this. Their needs become a major factor to develop an advanced invention and innovation of the standard White Cane. Previously, visually impaired person used a white cane as a guide, primarily to scan their surroundings for obstacles or a symbol of identification for blind people. The white cane has been useful for the blinds on improving their mobility but unfortunately the white cane has its limitation. It is unable to provide early warning as the cane could only detect the obstacles that are within the contact ranges. Consequently resulted in lack of timing for user to avoid any obstruction ahead. Hence, the design of Smart Sightless Cane (SSC) was aimed to innovate the existing white cane by emphasizing its safety features. The SSC is the combination of the Control Engineering process, Internet of Things (IoT) Technology Arduino Nano (SMART) and The Device (Cane). It is a prototype specifically constructed to aid visually impaired community on navigating their everyday life safely with self-reliance. Fabrication of SSC incorporates two ultrasonic sensors which functioned as a detection components of obstacles distance to a wide range of objects regardless of shape, color or surface texture. Also, a water sensor to recognize the presence of water in case of wet or slippery area, a light reflector to perform a noticeable light beam on the cane during night time and a buzzer to produce a tone, alarm or sound as an alert signal for emergency purposes and obstruction awareness either to public or the user. In addition, SSC is a traceable device which built with a Global Positioning System (GPS) that provides a visually impaired person with positioning, navigation, and timing (PNT) services to be able being traced by their family members and loved ones. Thus, a safer environment will encourage the visually impaired community to also have a confident lifestyle.

Keywords: existing, community, safe, white cane, ultrasonic sensor, water sensor, GPS

INTRODUCTION

Visual impairment is a term experts use to describe any kind of vision loss, whether it's someone who cannot see at all or someone who has partial vision loss. Some people are completely blind, but many others have what's called legal blindness. A white cane is a tool to get information about users surroundings by many people who are blind or visually impaired, in which allows its user to navigate the world around them safely and independently.

However, standard white cane does not detect physical obstacles above the waistline where it has caused several accident cases involving the visually impaired person. Hence, due to this major factor, SSC was developed to propose on enhancing the mobility by embedding ultrasonic sensor as added features to detect a wide range of distance and objects, a water sensor to recognize the presence of water in case of wet or slippery area including light reflector, buzzer as alarm and GPS as tracing component.

Smart Sightless Cane (SSC) designed specifically as a smart cane focusing on a high-technology function and safety features of the users. It is operated with a traceable device, Global Positioning System (GPS) that able to detect obstacles and watery surfaces. In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emission of the sound by the transmitter to its contact with the receiver. Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target). Thus, it is the most effective way to detect obstacles on all levels and distances.

A buzzer is assemble in this prototype to alarm users on their surroundings, as well as creates awareness to the public on their presence. Buzzer will be triggered when there is an obstacle and slippery roads ahead. A night reflector is also set up to be useful in low light conditions. A Global Positioning System (GPS) is also installed to facilitate easy tracing of the user by their family members in case of emergency purposes. The SSC aims to achieve satisfaction from visually impaired community towards the innovation of a standard White Cane which proves that the SSC contributed a safe navigation to them. So, this paper proposes the design of Smart Sightless Cane (SSC) which can be made with affordable cost and applicable to visually impaired community at any different ranges in accordance with its safety features.

OBJECTIVES

Here are the objectives of the study that can be listed:

To design a smart cane focusing on a high-technology function and safety features of the users.

To fabricate a traceable Smart Sightless Cane (SSC) that are able to detect obstacles and slippery areas with alarm.

To achieve satisfaction from visually impaired community towards the innovation of a standard White Cane which proves that the SSC contributed a safe navigation to them.

BENEFITS OF SSC

Community

Within the visually impaired community, SSC is a useful device specifically for blind people who lived alone. This could encourage them to be more confident to do their everyday routine independently. SSC operates with two ultrasonic sensors which offers an advanced technology system over a standard white cane because it has the ability to detect objects above and below the cane regardless of shapes and textures up to a range of 2m away.

Natural Surroundings

SSC is a piece of wood cane that has been innovated by adding Ultrasonic Sensor, Water Sensor, Global Positioning System (GPS), Arduino, Buzzer and push button in accordance with its functionality. It will not pollute the nature and threaten any live species as it only serves as a guide for people with visual impairments safely and efficiently through their environments.

Economy

From blind community to huge markets available, SSC will deliver mutual benefits to them. Blind community can improve their safety whenever and wherever they are, while markets community will be increased in profit demands.

Country

When there are more SSC productions, more visually impaired people will receive a technology-assisted aids that will be available to help them perform their daily activities with self-reliance no matter where. It enhances the utility of ordinary walking aids to produce solutions that are more reliable to a worldwide blind community.

METHOD AND MATERIAL

2.1 DESIGN PROCESS

The design process consists of several phases as shown in Figure 1. The problem is identified based on the needs and requirements based on research conducted via interview questionnaires. For that matter, different types of blind sticks or white cane was analyzed to determine the concept design of the SSC. The design of the blind stick was illustrated using AutoDesk Inventor software version 2019.

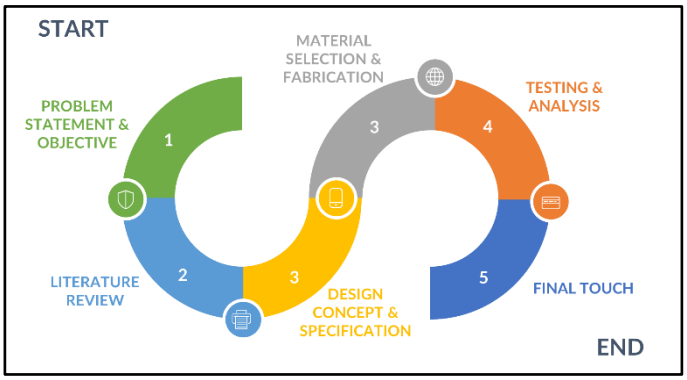


Figure 1: Flowchart process

2.2 DESIGN CONCEPT

The SSC encompasses several key features. This includes a warning system to quickly alert the user should there be obstacles ahead, the ability to detect the location of said user, detect water on the road, and differentiate between gutters, holes, stairs, and normal surface area. The alert system should incorporate different short and

long beeping sounds. The finished prototype integrates successfully a microcontroller, ultrasonic transducer, buzzer, water sensor, GPS, and a WIFI module as per Figure 2. As an added safety measure light reflector is also installed It also implements IOT whereby the stick can be controlled via a smartphone with a proprietary app.

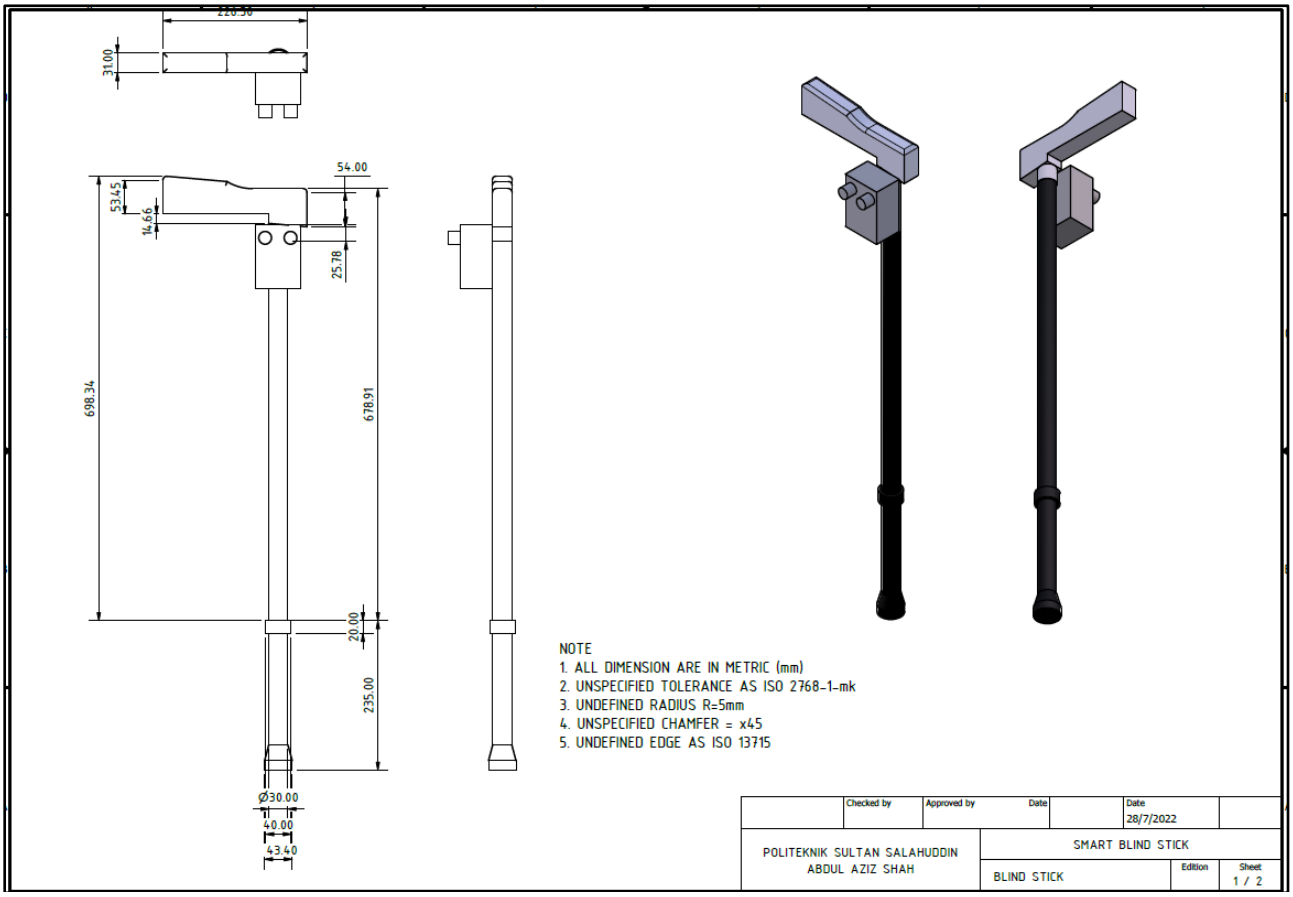


Figure 2: The schematic drawing with various views

2.3 DESIGN PRINCIPLES

The main component in this system is the microcontroller, Arduino Nano, and it controls all components in the system as programmed. Utilizing the concept of the Internet of Things (IoT), the SSC can be controlled via a smartphone. In addition, it can be connected to the mobile phone's wireless fidelity (WiFi) to track the user's location. Moreover, the ultrasonic sensors can detect any objects or obstacles in the range of one meter from the user. Once detected, a buzzer will be activated along with a phone alert sound that is synced simultaneously with the stick through a proprietary app. The smart stick is also equipped with an emergency button, which will trigger the Expressif (ESP) module to locate the whereabouts of the user. Accordingly, the guardians or family of the said user will receive an email with the coordinates and location of the visually impaired person. An installed water sensor can detect water or slippery roads, whereby it will trigger the buzzer to alert the user with a long beeping sound, while a short beeping sound is used for level walking floor detection. The difference in the sound alert is vital to avoid confusion.

A printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks, pads, and other features etched from copper sheets laminated onto a non-conductive substrate. Components (e.g. capacitors, resistors, or active devices) are generally soldered on the PCB. Advanced PCBs may contain components embedded in the substrate. PCBs can be single sided (one copper layer), double sided (two copper layers) or multi-layered (outer and inner layers). Conductors on different layers are connected via Multi-layer PCBs allow for much higher component density. Printed circuit boards are used in all but the simplest electronic products. Alternatives to PCBs include wire wrap and point-to-point construction. PCBs require additional design effort to lay out the circuit, but manufacturing and assembly can be automated. Manufacturing circuits with PCBs is cheaper and faster than with other wiring methods as components are mounted and wired with one single part.

Coding is basically the process of creating codes from one language to another. It can also be called a subset of programming since it actually implements the initial steps of programming. It involves writing codes in different languages as instructed. The machine can't interact with human communication and it only understands the machine code, which is the binary language. So, the main work of a coder is to translate the requirements into machine-understandable language. Coders need to have a thorough understanding of the project's working language. However, they mainly code as per the project's needs and instructed information. This is the initial step of developing a software product. Programming is the process of developing an executable machine-level programme that can be implemented without any errors. It is the process of formally writing codes so that the human inputs and corresponding machine outputs remain in sync. Creating code is the beginning step, and then programming is used to analyse and implement the same and produce the proper machine level output. It also involves all the critical parameters, from debugging and compilation to testing and implementation. Programmers use them to analyse and conceptualise the different aspects of communication and produce the correct machine outputs.

FINDINGS

Here are the findings of the study that can be listed:

The increasing of accident cases involving visually impaired people.

Difficult to adapt to a new environment due lacking method to detect an obstacle

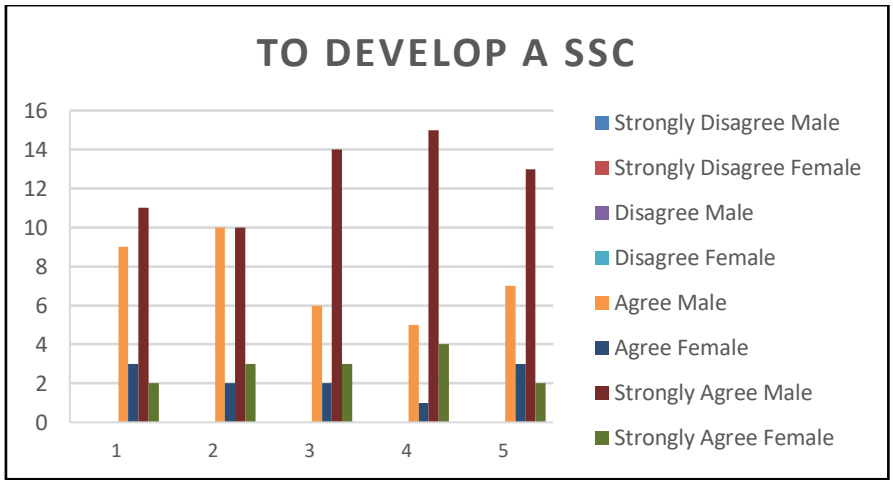
Failure of detecting veiled obstruction.

The result in both Table 1 and Table 2 should contain the result of the analysis required to report systematically, review clearly, and good interpretation with objective, questions and hypothesis research. Research findings will be reported in the form of tables, figures, and interpretations that will answer the research question.

	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
1	0	0	0	0	9	3	11	2
2	0	0	0	0	10	2	10	3
3	0	0	0	0	6	2	14	3

4	0	0	0	0	5	1	15	4
5	0	0	0	0	7	3	13	2

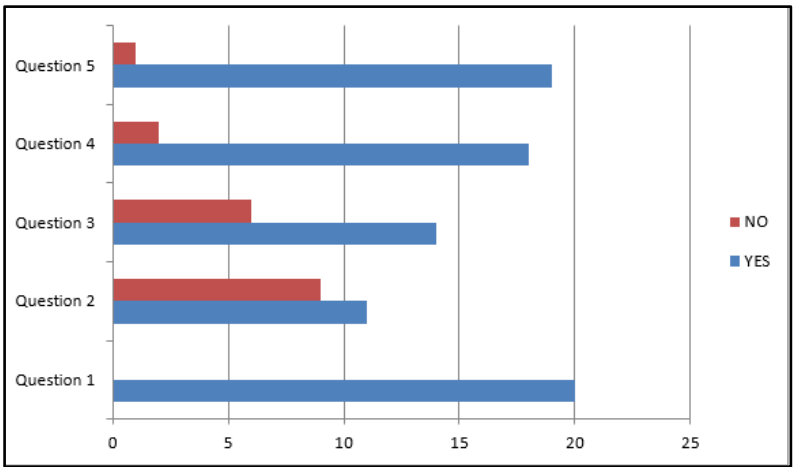
Table 1: Feedback First Result



Bar Graph 1: Illustrated Bar Graph from First Result

Question No.	**Yes**		**No**	
	Male	Female	Male	Female
1	10	10	0	0
2	4	7	6	3
3	8	6	2	4
4	9	9	1	1
5	9	10	1	0

Table 2: Feedback Second Result



Bar Graph 2: Illustrated Bar Graph from Second Result

Based on Bar Graph 1 and Bar Graph 2 above, it shows the results from both feedbacks. Question number representing the questionnaire and number of people represents the student.

CONCLUSION AND DISCUSSION

The finished prototype is shown in Figure 3. It operates by turning on the stick, where it will be connected to a smartphone via WIFI. Once connected, the ultrasonic sensors detect obstacles in ranges up to one meter in front of the user. Obstacles may and can include water including slippery floor, unevenness in the terrain such as holes, stairs and gutters as well as level surface floor. The sensor then transmits a signal to the GSM module which will then alert the user if there are any changes in the immediate area. As an added safety measure, should the user find themselves in need of help, a push on a designated emergency button will activate a signal to email the user's emergency contact. The email will contain the GPS location of the exact time the emergency button is pushed.

The prototype is tested to have a shallow or low learning curve, making it an easy replacement for the traditional white cane. It is an easy process even for the technology challenged person.

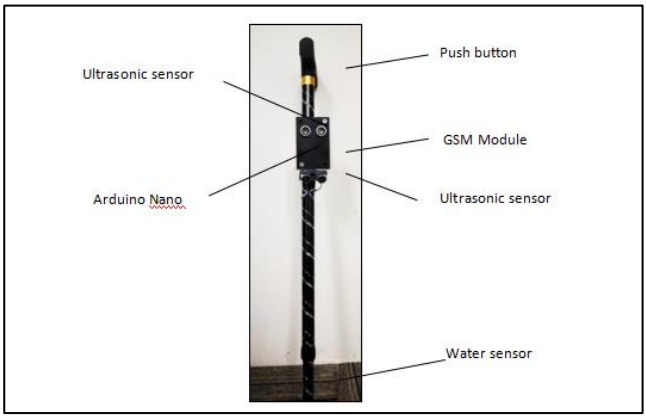


Figure 3: The Finished Prototype

A design for a prototype of SSC has been realized which aims to help visually impaired people conduct their everyday routine in a safer condition. The reason of this innovation is to emphasizes the safety features of the existing White Cane or Blind Stick by giving more value added. With the implementation of IoT, the activities of the visually impaired can be monitored through smartphones. The design and subsequent development of the prototype hopefully will help blind people in their daily routines safely. A safer environment will also help them to engage in more activities confidently, thus providing them with a better quality of life. In conclusion, safety is the most important aspect that should always be emphasized and pointed up in our daily life.

Blind people also should be given equal opportunity to feel that they are safe always and their safety is assured. It also will increase their confidence in living their normal life. As a result, we can conclude that this SSC project is a device that implements the theory of the Internet of Things which we can monitor the activity of blind people through our mobile phone and control systems to trigger the sensor. This paper provided the necessary details to design a prototype of the SSC which helps visually impaired people to walk more safely. The prototype is built on the Arduino platform with the help of its software to integrate proper assembly codes for which it achieved the required intelligence to increase the mobility of the visually impaired people. Overall, designing and developing this project will helps blind people do their daily routines and walk more confidently using this project innovation that had emphasizes the safety features of the existing White Cane or Blind Stick.

RECOMMENDATIONS

The current features of SSC focus on location detection through an open-source application which can monitor in the BLYNK application. But it only can be opened in a certain type of Android mobile phone and cannot be open in IOS operating system that does not support open-source application due to the high-security system. For future innovation, an idea to develop an application that can be operated on both systems which are IOS and android to fulfill the user's desire. Last but not least, the usage of the Infrared Sensor is more precise in obstacle detection compared to the ultrasonic sensor. The infrared Sensor is well-known for its precision and accuracy in detecting obstacles because lasers detect faster than waves. This means the time to react is faster than in ultrasonic waves.

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