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Microcontroller-Based Alarmed Ambulatory stick For The Vision Impaired

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ABSTRACT: *No Light Perception (NLP) in subjects has been clinically certified as a complete lack of form and visual light perception while having only light perception is the ability to articulate light and general direction of its source from the dark. Subjects with severe visual impairments are always in danger of independent mobility. Microcontroller-based alarmed ambulatory stick for the vision-impaired in this paper aimed to design a microcontroller based ambulatory stick with an alarm system to allow the vision impaired subjects' mobility with no assistance. It is purely a simple mechanical device designed to detect static obstacles on the ground which also includes uneven surfaces, holes and steps. AT89S52 microcontroller was used to implement the entire activities of the system. Proteus 8.0 software was used to simulate the system model while PM-51 Macro Assembler and Top win version 6 Software and programmer were used for program development. This system can detect an obstructive object from a distance of one meter and beep an alarm to alert the subject to move to an alternative suitable route. The prototype has been effectively prove n to allow the visual impaired subjects move dependently.*
KEYWORDS*: Vision, Impairment, Ambulatory, Stick, Obstacles*

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I. INTRODUCTION

Blindness is frequently used to describe severe visual impairment with residual vision. Total blindness is the complete lack of form and visual light perception and is clinically recorded as No Light Perception (NLP) (Pooja and Hemant, 2013).Survey made by World Health Organization (WHO) globally in 2010, estimated 285.389 million to be visually impaired (World Health Organization, 2014). The visually impaired do encounter the problems of orientation and mobility more especially, in an unknown environment, preventing them from travelling independently (Kumaran, 2013)

Moreover, efforts have been made to improve their mobility by use of technology.

Before now, one of the techniques applied is the use of orientation and mobility specialist who helps as well as trains them to move on their own. Another way is the use of guide dogs that are trained specifically for the blind people to ensure free movement by navigating around the obstacles to alert the person to change his or her way. These methods have some limitations which include the difficulties of inaccessibility of mobility specialists as well as provide for their necessary needs. For the trained dogs, to understand the complex directions posed by them could be very difficult. Though the cost of these trained dogs could be very expensive, they are very effective only for the period of five years (Arasu and Kumaran, May 2014).

Furthermore was the introduction of a walking cane. Walking cane is a light, simple, portable and purely mechanical device dedicated to detect static obstacles on the ground, uneven surfaces, holes and steps through a simple tactile-force feedback. Its object detection is very limited to its own size and cannot be used for dynamic obstacles detection nor obstacles located on the floor (Kher Chaitrali, et al., 2014)

Recently, Electronic Travel Aid (ETA) device that help the blind to move freely in an environment regardless of its dynamic changes was developed to enhance the mobility of blind people that rely on signal processing and sensor technology. They operate like the radar system that uses ultrasonic fascicle or laser to

identify height, the direction, and speed of fixed and moving objects. The distance between the person and the obstacles is measured by the time of the wave travel (Joao, et al., 2011, Benjamin and Alina, 2012)

However, all the systems discussed above have the ability to inform the blind of the presence of an object at a specific distance in their view but lacks the ability of alerting the user with a sound signal. This project has come to overcome this.

II. SYSTEM BLOCK DIAGRAM

Figure 1 shows the block diagram of Microcontroller-based alarmed ambulatory stick for the vision-impaired. It consists of the power supply unit, the infra-red sensor, the microcontroller, and the alarm unit.

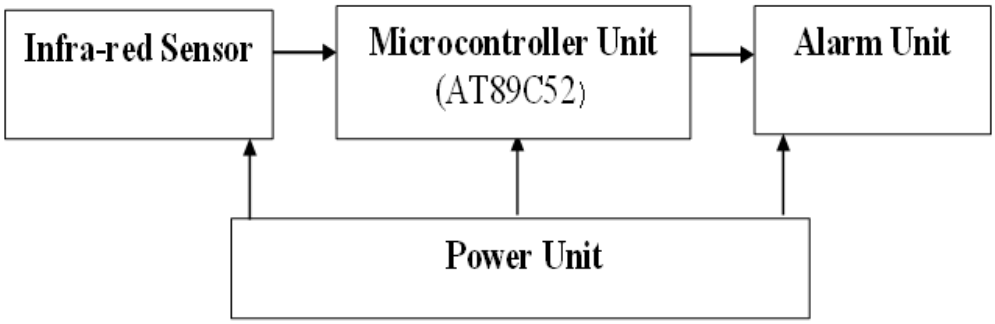


Figure 1: Block diagram of microcontroller-based alarmed ambulatory stick

The system is powered by a 9V battery. The output noise from the battery source is filtered by a 100uF capacitor. Two voltage regulators (LM7805) were used to provide 5V fixed output for the microcontroller and the alarm unit. 1kΩ resistor is used to limit current going through the LED power indicator.

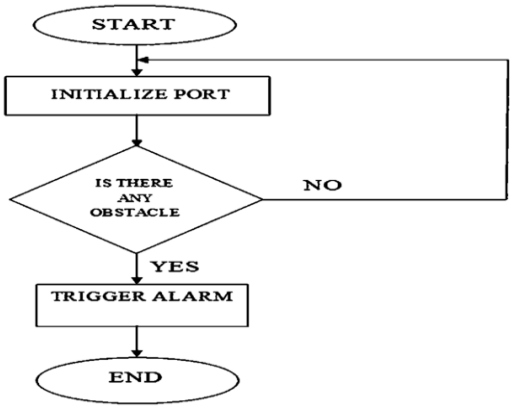
The Infra-Red (IR) Light Emitting Diode (LED) (TSFF5210)is to emit infrared light, some of the light reflects back from the surface of the object and is detected by Infrared Photodiode (IR Receiver), the intensity of receiving radiations by IR Receiver is used for distance detection of obstacles. The higher intensity shows the closer obstacle. To analyze the output of IR receiver, it is fed into a comparator circuit which is an operational amplifier (op-amp) (LM 358M).When there is no receipt of radiation by the IR receiver, the potential at the inverting input goes higher than that non-inverting input of the op-amp and output goes low, hence no alarm. When there is receipt of radiation by the IR receiver, the potential at the inverting input goes low and thus the output of the LM 358Mgoes high and causes the alarm to blow.

Micro-controller (AT89S52) is used as an interface between sensor unit and the alarm. The output of the IR sensor is continuously fed into microcontroller. When its output is low (0), no object is detected hence there will be no alarm but when the output is high (1) there is object detection by sensor hence it triggers the alarm. It is programmed with PM-51 Macro Assembler and Top win version 6 Software to control the system.

The alarm unit which serves as the output unit is made up of a transistor switch (BC547 transistor). The transistor switch is forward biased when the microcontroller receives signal from any of the input sensor and an obstacle is indicated the system will be triggered.

3 System Flowchart

Figure 2 shows the system flowchart of microcontroller-based alarmed ambulatory stick.



4 System Implementation

Figure 3 shows the circuit diagram of the system which was simulated in Proteus 8.0 software environment and then implemented on a Vero board.

The components that made up the system include:

- IR LED TSFF5210
- AT89S52 microcontroller chip
- LM358 comparator chip
- BC547 transistor NPN
- 33PF paper capacitor
- LM7805 voltage regulator
- 10 microfarad by 66volt electrolytic capacitor
- 10k fixed resistor
- 10k variable resistor
- 9v Power supply
- The alarm unit (Buzzer)

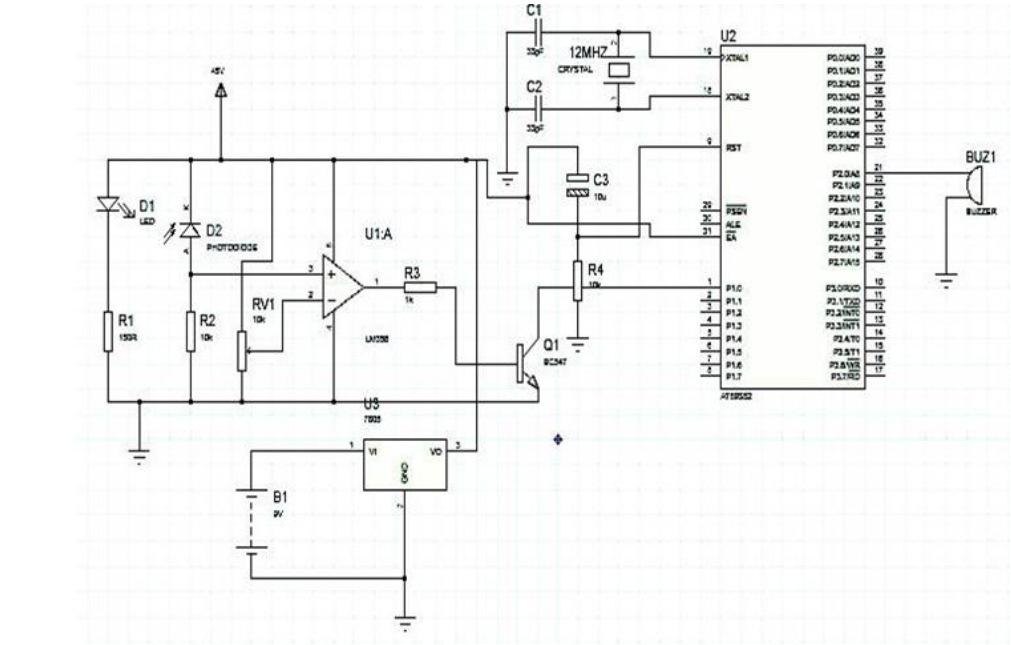


Figure 3: Circuit diagramof Microcontroller-based alarmed ambulatory stick

Figure 4: Prototype of Microcontroller-based alarmed ambulatory stick

5 System Analysis and Results

The different hardware units of the complete system were tested to ensure that they are in good operating condition. Figure 4 shows the prototype of the system.

After the prototype of the system was successfully built, an obstruction detection test was conducted. It was also observed that only obstacles at a distance of one meter from the sensor triggered an alarm. This confirmed that the system performed as expected. The system was not designed to detect obstructive objects of more than one meter distance.

6 Conclusion and Recommendations

Microcontroller-based alarmed ambulatory stick has effectively been proven to allow the visual impaired subjects move dependently. However the system is not able to detect obstacles of distances above one meter. Also, it cannot detect the specified subject location or motion obstructive objects. All these limitations are recommended as future work.

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