SMART WALKER WITH ARTIFICIAL INTELLIGENCE IMPLEMENTATION

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Abstract

Visually impaired, elderly and physically impaired people use walking stick as a conventional mobility support. Although it provides primary guidance and help to maintain self-balance and to circumvent obstacle, this device limits independency of people. Only basic support is provided by the walking stick and hence can cause accidents in some cases due to poor assistance. This project is developed to show case automatic mobility support which collect relevant data (heart beat rate, obstacle position) using wireless sensors, analyses the data and provide necessary guidance using the vibration circuit(headphone or speaker).The processing is done in real time by arduino board and ESP8266 NODE MCU which is programmed beforehand. The results are send back to cloud service using Wi-Fi, from where information is passed as message to the doctor. Artificial intelligence enables the user to communicate with the doctor through cloud service to clarify the doubts in case of health issues.

Keywords- Vibration circuit; arduino board; heart rate; obstacle detection; cloud service; sensors

I. INTRODUCTION

The ability to navigate from one place to another isan integral part of daily life and vision plays a critical role in providing this ability. For a physically fit person it is quite simple to move around in a known surrounding and in a totally new environment. But for people with visual impairedness or other disabilities, can move around easily in well-known surrounding, but to move in a new environment they need to be assisted by family or friends [1]. There is an immediate need to provide a facility to support the mobility of blind and visually impaired people to improve their self-confidence and to reduce their dependence on others. Even though numerous frameworks have been developed to aid visually impaired and elderly, their applications is limited due to various reasons. A friend or family member and even guide dogs assist them in unknown environment. The use of smart walkers over conventional walker has been proposed to improve the living conditions of the elderly with visual impairness. This equipment is beneficial over the conventional assistive methods with support from sensors and health monitoring systems along with Man-Machine Interference [2].

2. LITERATURE REVIEW

A. Obstacle detecting section

This section makes use of both infrared sensors and ultrasonic sensors for implementing obstacle detection circuit. IR sensor which is an electronic device consist ofIR transmitter and IR receiver[3] IR transmitter is an LED which transmits infrared rays which are invisible to human eyes, when this rays falls on to the receiver which is an IR photodiode indicates the presence of obstacle in front of them [4], [5]. This system makes use of two IR sensors- one placed at the left side and the other at the right side of walker frame with ultrasonic sensor placed at the centre of the frame.

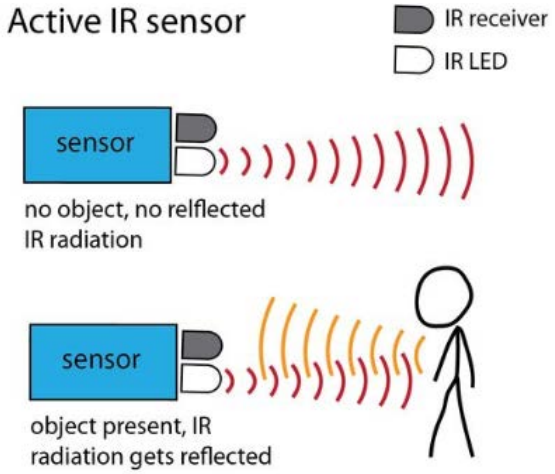

Fig 1: IR sensor functioning

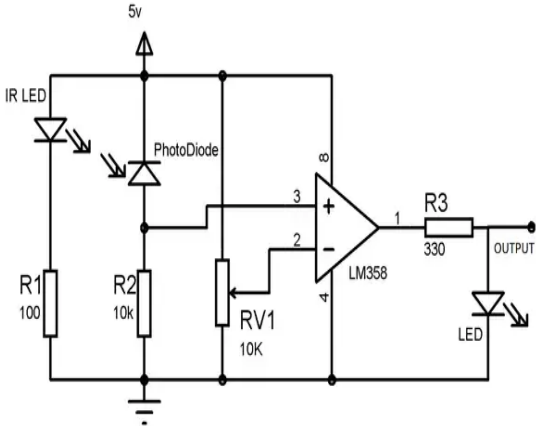

Fig2: IR sensor circuit

Ultrasonic sensors have larger range than the IR sensor. A single ultrasonic sensor located at the centre of the frame enables obstacle detection within the range of the sensor.

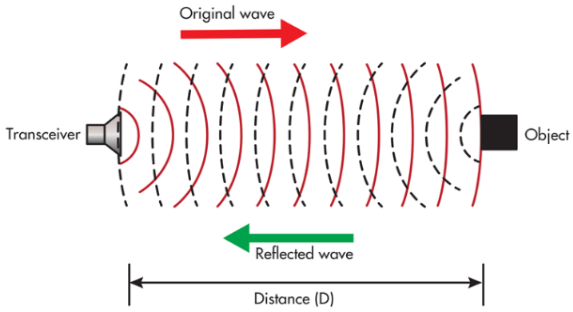

Fig3: ultrasonic sensor functioning.

Ultrasonic sensor incorporates a transducer which emits sound waves when a high voltage electrical pulse is applied to the sensor [6], [7]. This waves strikes any object that is present in front of it and reflects these waves as echo. The receiver in the sensor receives this echo from which distance can be calculated using the formula

$$\text{Distance} = .0340/2 \qquad (1)$$

B. Health Monitoring section

Health monitoring system incorporates a pulse/heart rate sensor as the crucial element [7]. The sensorencompass an LED which is placed in a manner on the fingertip that the LED faces the vein on the fingertip which emits light. During a heartbeat, flow pattern of blood in the veins changes which appears as an increase in pressure. The LED emits light which gets absorbed by the tissues. During a heartbeat a change occurs in the amount of light that gets absorbed by the tissues due to increase in blood flow in veins. Volume of blood in the tissues determines the amount of light that gets absorbed by the tissues. Sensor consist of detector circuit capable of producing an electrical output proportional to the heart beat rate.

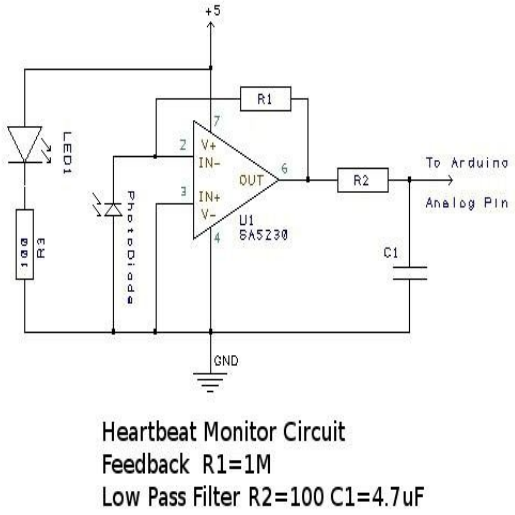

Fig 4: pulse sensor schematic

C. Controlling Unit

There are two major controlling units in this project. It makes use of an arduino board and ESP8266 NODE MCU as the central control unit. Esp8266 module is a microcontroller unit with inbuilt Wi-Fi connection which sends the measured data to a cloud service using Wi-Fi. Serial communication between NODE MCU and arduino board enables the connection of various components required for the system. Both these units can be connected individually to the computer using USB cable and can be programmed using software Arduino IDE. The pulse sensor is connected to the inputs of NODE MCU whileIR sensors, ultrasonic sensor and the vibration system is connected to the input of arduino board. The NODE MCU unit is responsible for communicating with the cloud service to transfer the information obtained from pulse sensor to both doctor and family.

Serial operation between these units are made possible using serial communication.

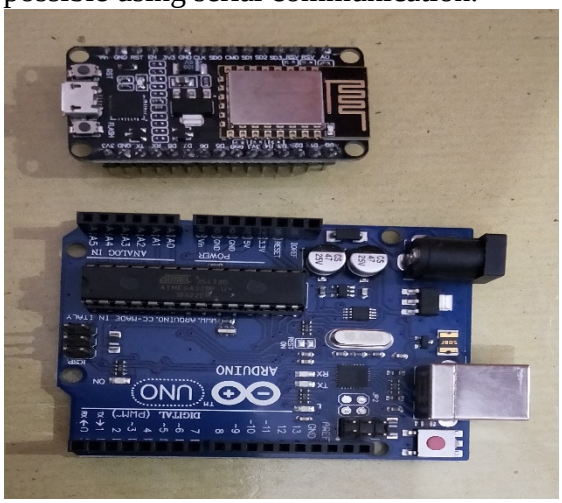

Fig 5: arduino board and ESP8266 node MCU

D. Vibratory System

Visually impaired people are unable to see the obstacles that comes their way and so communication with the user is made possible using the SD card –speaker system. Each sensor is associated with a sound saved in the SD card which gets activated upon obstacle detection. The SD card reader enables the connection of sd card with arduino board.

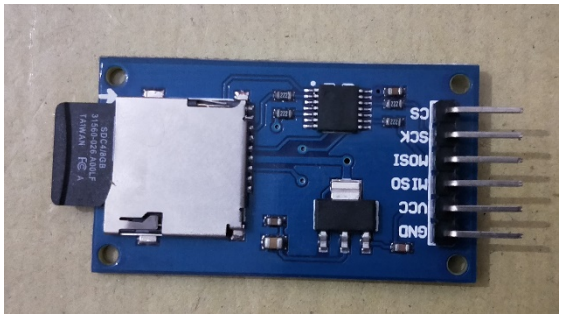

Fig 6: SD card with SD card reader.

Here we make use of two IR sensors hence two sounds corresponding to each sensor is stored. When obstacle is detected by IR sensor 1 then sound stored in SD card corresponding to the sensor is activated. Headphones or speaker is used for vibration circuit which is connected to output pin of arduino.

E. User Interface

Adafruit.io is a cloud service, to which user can send sensed data [11]. Internet enables connection between user and cloud service and the datasensed by the pulse sensor is send to this cloud service. Doctor / family member can login to this account created for the user andgive instructions to the user in case of poor health.

3. PROPOSED SYSTEM

The smart walker with AI implementation provides an effective method to provide support to the visually impaired elderly people by providing simple electronic circuitry while utilizing the present available technologies at most. Various versions of smart walker were being tried all over the world, but there were so many limitations in terms of adaptability, complexity in design, as well as cost for the system. This project presents a smart walker well suited for the people in India which has a simple design. One advantage of this system is the presence of health monitoring system to monitor the heart beat rate which indicate the working condition of the heart of that person and alert him in case any fluctuations in the value. Enables the doctor/family to get real time information about the health status of the user. AI implementation using raspberry-pi enables the user to clarify their doubts with doctor using mic-speaker system connect with the user.

4. BLOCK DIAGRAM

This project consist of two parts- hardware section and cloud service section.

The hardware section consist of the arduinouno board connected with ESP8266 NODE MCU which communicates with each other serially. Two IR sensors, ultrasonic sensor, pulse sensor connected to Arduino.ESP8266 module avoids the need for separate Wi-Fi module. The connection between SD card and arduino is made through SDcard reader.

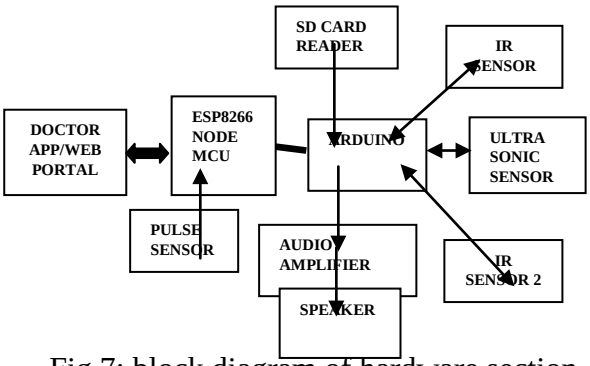

Fig 7: block diagram of hardware section.

Figure 7 shows the block diagramof hardware-section connection. When IR, ultrasonic sensor detects the presence of obstacle in front of walker, activated the sound stored in the SD card for that particular sensor which detected the obstacle. Then sends voice message to the user through the vibration system (headphones, speaker) to guide the user. This system alerts

the user through voice message as long as obstacle is present in its path. The data measured by pulse sensor is transferred directly to cloud service using Wi-Fi.

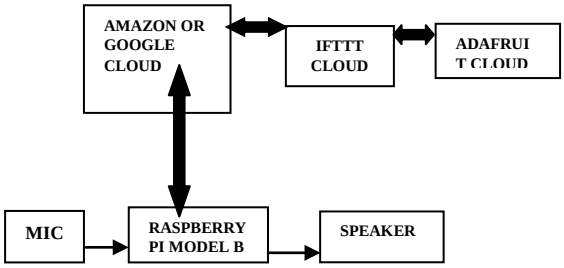

Fig 8: block diagram of cloud service section with AI implementation

The cloud service section consist of adafruit.io used as cloud service. User need to create an account in adafruit.io and IFTTT, hence by logging on to ifttt.com/adafruit user can connect IFTTT account with adafruit account. The software implementation is carried out using adafruit.io, so the instantaneous pulse sensor value gets displayed in adafruit account. By creating a trigger in IFTTT, the value available in adafruit can be viewed in IFTTT. By connecting IFTTT account with amazon/ google cloud and logging on to IFTTT account doctor or user can view the data. Utilization of raspberry-pi, enables doctor and user can communicate with each other. Also doctor can provide guidance in case of health failure.

5. MATERIALS REQUIRED

Hardware requirements

1. ARDUINO UNO Board
2. ESP8266 NODE MCU
3. Raspberry-pi
4. IR sensors
5. Ultrasonic sensor
6. Pulse sensor
7. SD card
8. SD card reader
9. Headphones
10. Jumper wires

Software requirements

1. Arduino IDE
2. Easy EDA
3. Adafruit.io
4. IFTTT

6. CONCLUSION

Smart walker with AI implementation is a project with great social importance. It presents a system that is highly cost effective and enables easy utilization by people, increases self-confidence and motivates the users to believe on their own capabilities. Effective and efficient employment of this system for blind and visually impaired elderly is possible using simple techniques in comparison with other mobility support systems. Smart walker system provides a single system consisting of multiple facilities- obstacle detection, health monitoring, mobility support and guidance.

7. FUTURE SCOPE

The smart walker system presented in this project have great applications. Artificial Intelligence implementation accompanied by video streaming and processing enables the movement of visually impaired in known and unknown environment. Provision of GPS in case assistance is required by the blind will be beneficial in future. Incorporation of Advanced health monitoring components enables faster and accurate measurement of health. All these would finally help to reduce accidents faced by blind and elderly. Implementation of all these techniques presents a walker that is socially and economically beneficial in future.

8. REFERENCE

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