

Step Simple – Guiding the Visually Challenged

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Abstract: This project presents the design and implementation of a smart blind stick prototype aimed at enhancing the mobility and safety of visually impaired individuals. The blind stick integrates an ultrasonic sensor, USB web camera, speakers, to provide object detection. The prototype leverages a Raspberry pi controller to efficiently manage the sensor data and interactions.

Keywords: embedded system, raspberry pi, ultrasonic sensor, YOLO.

1. Introduction

The project introduces a groundbreaking initiative focusing on the design and implementation of a smart belt prototype named the Blind Stick. This innovative device is tailored to augment the mobility and safety of visually impaired individuals by integrating cutting-edge technologies. At its core, the Blind Stick utilizes a Raspberry pi microcontroller to efficiently manage various components, including an ultrasonic sensor, USB web camera, speakers. The combination of these elements enables the prototype to offer essential functionalities such as object detection, alert generation, and location sharing.

The ultrasonic sensor plays a pivotal role in enhancing user safety by detecting obstacles in the path of the visually impaired individual.

The Blind Stick prototype takes a significant leap forward by incorporating computer vision techniques, leveraging the YOLO (You Only Look Once) framework. Through the use of a USB web camera connected to a PC, the Blind Stick captures images, and YOLO identifies detected objects. The user is then provided with audio alerts through earphones, offering a more comprehensive understanding of their surroundings.

2. Embedded System Implementation

A. Introduction

An embedded system is one kind of a computer system mainly designed to perform several tasks like to access, process, store and also control the data in various electronics-based systems. Embedded systems are a combination of hardware and software where software is usually known as firmware that is embedded into the hardware. One of its most important characteristics of these systems is, it gives the o/p within the time limits. Embedded systems support to make the work more perfect and convenient. So, we frequently use embedded systems in simple and complex devices too. The applications of

embedded systems mainly involve in our real life for several devices like microwave, calculators, etc.

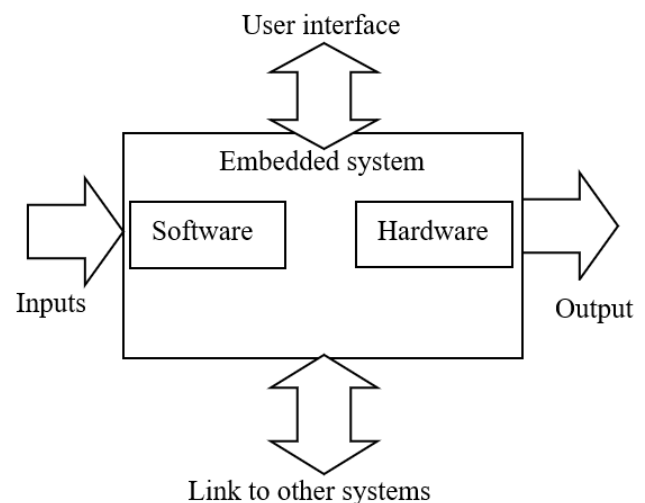


Fig. 1. Overview of embedded system

B. Embedded System Hardware

As with any electronic system, an embedded system requires a hardware platform on which it performs the operation. Embedded system hardware is built with a microprocessor or microcontroller. The embedded system hardware has elements like input output (I/O) interfaces, user interface, memory and the display. Usually, an embedded system consists of:

- Power Supply
- Processor
- Memory
- Timers
- Serial communication ports

Embedded systems use different processors for its desired operation. Some of the processors used are

- Microprocessor
- Microcontroller
- Digital signal processor

C. Embedded System Software

The embedded system software is written to perform a specific function. It is typically written in a high-level format and then compiled down to provide code that can be lodged within a non-volatile memory within the hardware. An embedded system software is designed to keep in view of the

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three limits:

- Availability of system memory
- Availability of processor's speed
- When the system runs continuously, there is a need to limit power dissipation for events like stop, run and wake up.

3. Methodology

A. Flow Diagram

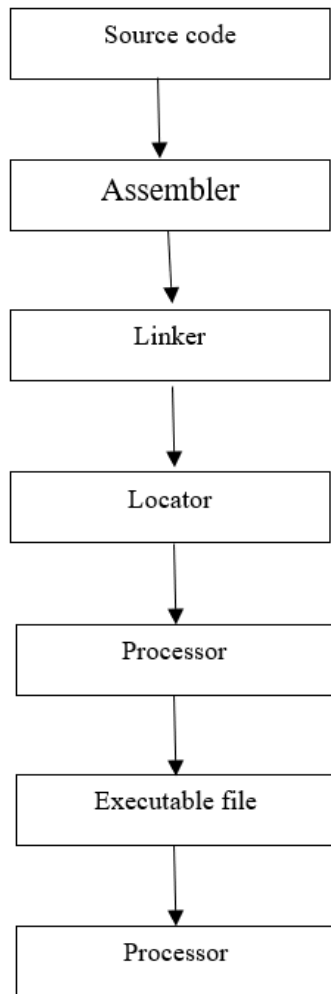


Fig. 2. Flow diagram

The flowchart in Figure above outlines the Flow of burning source code to processor:

1. *Source Code*: This is where the process begins. Source code is the human-readable form of a program written in a programming language like C, C++, Java, etc.
2. *Assembler*: The source code is first passed through an assembler. The assembler converts the source code into machine code, which is a low-level representation of the program that can be understood by the computer's processor. This machine code is often referred to as object code.
3. *Linker*: The object code produced by the assembler may have references to functions or variables that are defined in other parts of the program or in external

libraries. The linker is responsible for resolving these references by linking together various object files and libraries to create a single executable file.

4. *Locator*: In some systems, after linking, there might still be unresolved memory addresses or relocation information in the executable. The locator is a hypothetical step representing the process of resolving these addresses and preparing the executable for loading into memory.
5. *Executable File*: The output of the linker is an executable file. This file contains the machine code for the program, along with any necessary data and metadata, in a format that the operating system can understand.
6. *Processor*: Finally, the executable file is loaded into memory and executed by the processor. The processor interprets the instructions in the executable file and performs the necessary computations to run the program.

Each step in this process is crucial for converting the human-readable source code into instructions that the processor can execute. This diagram illustrates the flow of data and transformations as the program moves through each stage of compilation and execution.

4. Conclusion

In conclusion, the development and implementation of the Blind Stick smart belt prototype represent a significant leap forward in addressing the challenges faced by visually impaired individuals in terms of mobility and safety. By integrating advanced technologies such as ultrasonic sensors, a USB web camera, speakers, and a switch, the Blind Stick offers a multifaceted solution to enhance the independence and security of its users. The ultrasonic sensor plays a crucial role in detecting obstacles, providing real-time alerts through a buzzer to warn users of potential collisions. The incorporation of computer vision techniques, specifically the YOLO framework, adds an extra layer of functionality to the Blind Stick. By capturing and analyzing images from a USB web camera, the prototype can identify objects in the user's surroundings and convey this information through audio alerts, delivered via earphones. This not only improves object recognition but also contributes to a more comprehensive understanding of the environment. The collective integration of sensors and modules in the Blind Stick prototype underscores its potential to make a substantial impact on the lives of visually impaired individuals. The obstacle detection, emergency alert system, challenges faced by the visually impaired community. As with any innovative project, there is room for future enhancements. Potential areas of improvement include refining the prototype for increased usability, optimizing the object detection algorithm for greater accuracy.

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