Electric Service Dog

Embedded Systems Final Project

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Introduction

The integration of embedded systems into assistive technologies has opened newer avenues in the betterment of the lives of people with disabilities. In this light, one example innovation would be the creation of an Electric Service Dog-an assistive device that provides support similar to that of a service animal. Such devices would be equipped with microcontroller-based systems for accomplishing critical tasks for users to move around, accomplish routine tasks, and enjoy a more independent lifestyle.

This report presents the design and implementation of an Electric Service Dog system using the PIC16F877A microcontroller. The major objective of this project is to come up with a low-cost and reliable solution to integrate sensors, actuators, and control mechanisms to mimic basic functions of a service animal. The focus of the system will be on the detection of obstacles, and environmental alerts, showing the potential in the field of embedded systems for assistive technologies.

Background

During the past couple of decades, the development of assistive technologies has been favored by advances in microelectronics, artificial intelligence, and robotics. Traditional service animals, such as guide dogs, are highly valuable for the visually, auditorily, or mobility impaired individual. However, service animals require expensive and time-consuming training and maintenance, and availability is often limited. Embedded systems represent a scalable alternative to creating programmable devices that can automate assistive functions.

The PIC16F877A microcontroller is a very common, cost-effective platform that is highly versatile and has robust features. This microcontroller has 8K words of program memory, a

10-bit ADC, and multiple communication interfaces, making it a good starting point for developing complex control systems. Its ability to interface with various sensors and actuators makes it an ideal choice for implementing the Electric Service Dog's functionalities.

This project employs the use of the PIC16F877A in designing a compact and functional system, while other components will include ultrasonic sensors for obstacle detection, and servo motors providing mechanical actuation. With the feasibility of using PIC16F877A, the Electric Service Dog promises an employable and effective solution for people who need assistive support.

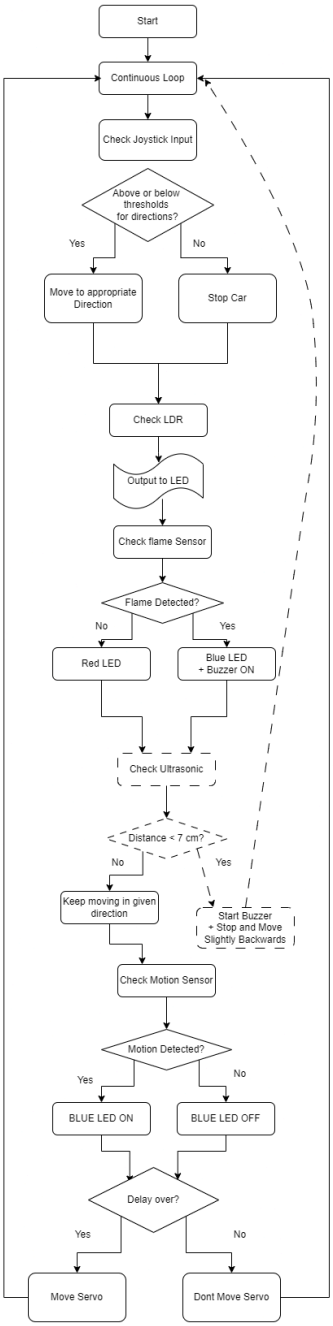
Design

The design of the Electric Service Dog integrates a range of sensors, actuators, and control mechanisms, all managed by the PIC16F877A microcontroller, to deliver assistive functionalities. The key components and their roles are outlined below:

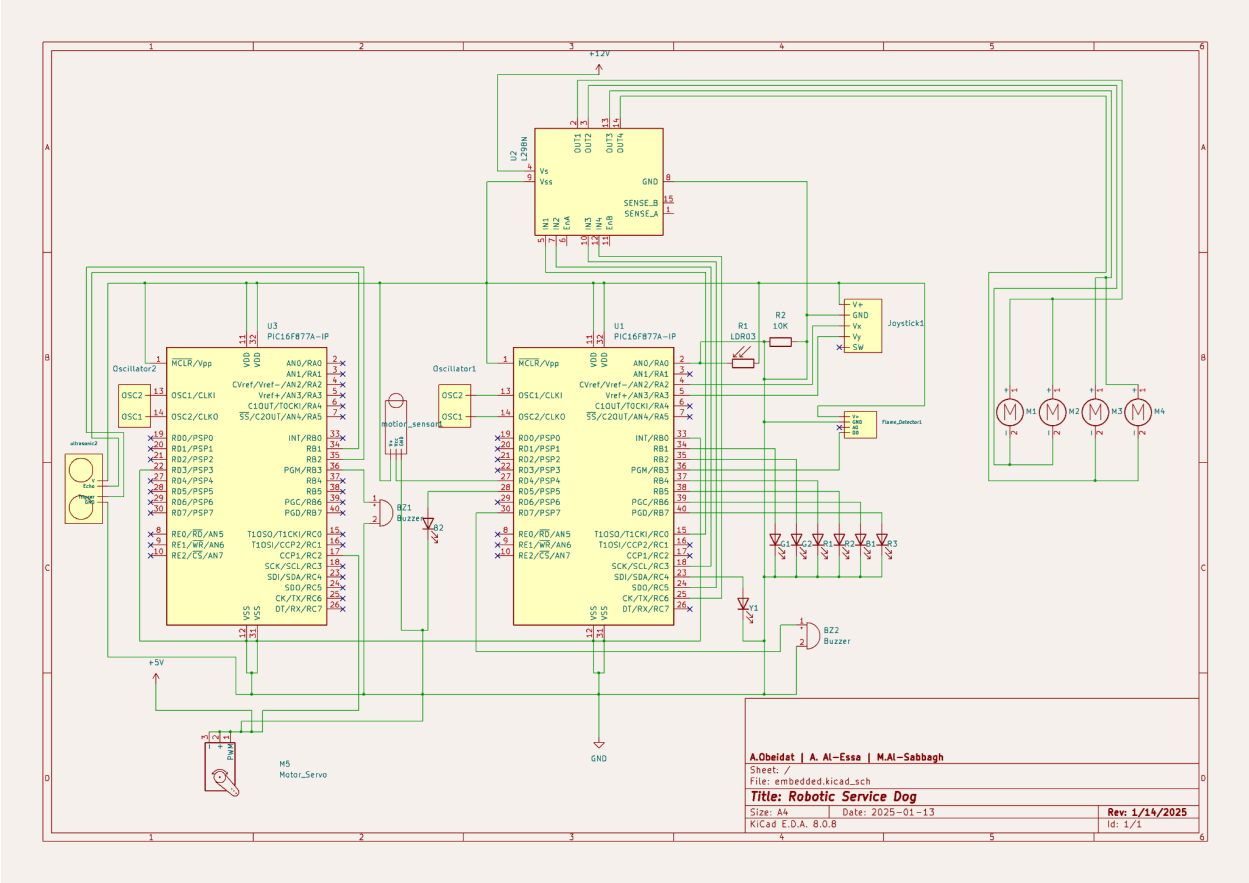
1. **Joystick for Movement and Direction Control**:
   A joystick serves as the primary input device for controlling the movement and direction of the Electric Service Dog. The user can manually guide the device, enabling precise navigation and responsiveness in various environments.
2. **Ultrasonic Sensor and Servo Motor**:
   An ultrasonic sensor is mounted on a servo motor to scan the surroundings for obstacles. When an obstacle is detected within a predefined short distance, the system triggers an interrupt, causing the dog to move slightly backward and activate a buzzer, alerting the user of the obstacle.
3. **Flame Detector**:
   A flame detection sensor monitors the environment for potential fire hazards. When flames are detected, the system turns on an LED and activates a buzzer with a distinct sound pattern. This feature provides early warning, enabling the user to take timely action.
4. **Motion Sensor**:
   A motion sensor detects movement in the vicinity and turns on an LED to alert the user to activity nearby, enhancing environmental awareness.
5. **LDR (Light-Dependent Resistor)**:
   An LDR is used to sense ambient light levels. In low-light conditions, it activates all LEDs to improve visibility for the user and ensure safe navigation in darker environments.

By integrating these components, the Electric Service Dog combines manual control with automatic safety and navigation features, offering a reliable, multifunctional assistive device for users with visual impairments.

Flow Chart:


Start
Continuous Loop
Check Joystick Input
Above or below thresholds for directions?
Yes
No
Move to appropriate Direction
Stop Car
Check LDR
Output to LED
Check flame Sensor
Flame Detected?
No
Yes
Red LED
Blue LED + Buzzer ON
Check Ultrasonic
Distance < 7 cm?
No
Yes
Keep moving in given direction
Start Buzzer + Stop and Move Slightly Backwards
Check Motion Sensor
Motion Detected?
Yes
No
BLUE LED ON
BLUE LED OFF
Delay over?
Yes
No
Move Servo
Dont Move Servo

Hardware Schematic:



Problems and Recommendations

Issues arisen during the development of the Electric Service Dog include, but are not limited to: fragility of the PIC16F877A microcontroller pins that can be easily bent or broken when handling the chip and assembling it, the improvement of which should be pursued in further versions by soldering the pins into a socket or protective casing to avoid excessive wear when inserting and removing from the breadboard. Also, the position of the battery compartment at present seriously upsets the balance and stability of the whole device. Relocation towards a more centralized or lower part will help the better distribution of the weight of the device. Last but not least, the joystick cable was felt to be much too short for comfortable operation by a user. Employment of a longer, more flexible cable would vastly increase ease of use/accessibility and comfort for users. These changes would render the system robust, stable, and generally more user-friendly.

Conclusion

The Electric Service Dog successfully applied embedded systems to the design and building of assistive devices for persons with some form of disability. The system, implemented on a PIC16F877A microcontroller, was designed to enable the blind to explore the environment safely and effectively. The device utilizes ultrasonic sensors in obstacle detection and navigation, hence enabling users to confidently move within their environments.

Also, it contains flame detection, which can give an early warning against the fire hazards. This is for improving the safety of the users for detecting the possible flames and warning the user in advance prior to worsening of the situation to ward off potential harm.

In addition, the successful implementation and operation of this project give reason to show how cost-effective embedded systems can actually work out several real-life difficulties for visually impaired people. Refinement followed by scaling will be able to place the Electric Service Dog as a useful tool aimed at an improved quality of life for its users.