

Design and Development of a Real-Time Smart Robot for a Marathoner

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Abstract— Now a days, robots are used to provide service to humans in different fields. A service robot is a robot that performs useful tasks for humans or equipment. They are mainly used for noncommercial tasks and do not include industrial manufacturing and automation applications. one such application is making use of a robot in a long distance running race. Marathon is one of the most popular athletic events of all times. Amateur marathoners face a number of difficulties while training for a race. They must keep track of the path and also carry essential items such as water, food and clothes. Our aim is to develop a Marathoner Service Robot (MSR) that would assist the runner while training.

The main purpose of this project is to design an MSR that would move along the track specified for training. It must be able to detect the obstacles in the outdoor environment. Also, the marathoner's requirements are fulfilled by carrying his essential items that are necessary during training. The whole algorithm, processing and monitoring is accomplished by using motors, sensors, audio player and voice recognizer interfaced with ARM7 microcontroller.

Index Terms— ARM7 microcontroller, audio player, motors, sensors, voice recognizer.

I. INTRODUCTION

Marathon is one of the most popular events of all times. The first marathon was held in 1896. More than 500 marathons are held throughout the world each year [1].

In a marathon, the beginning is rather easy because the runners have a lot of stored energy. As the runners move away from the starting line, they get slower as their energy level decreases. By the end of the race, they are dead tired and some do not even make it. It is the series performance that places great demand upon the runner not only during the marathon but also in the training. The important element in marathon training is the long run. The amateur marathoners face a

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number of difficulties such as keeping track of the path and carrying essential items like water, medicine, food and cloth [2]. So, we have designed a real-time smart robot for a marathoner.

II. METHODOLOGY

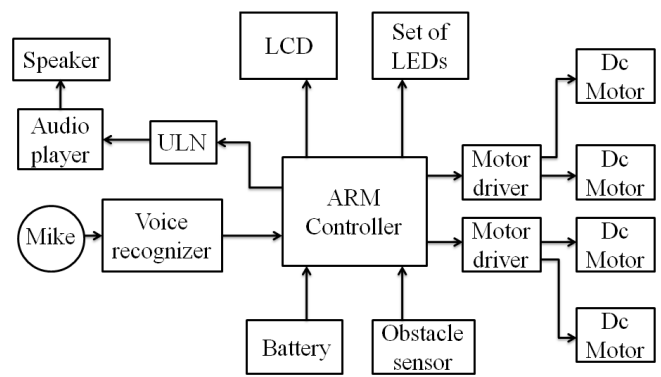


Fig. 1: Block Diagram

The ARM7 (LPC2148) controller is used to interface all the devices such as motor driver, audio player and voice recognizer. The block diagram is shown in Fig. 1. This is a four wheeled robot which runs with the help of DC motors and DC driver. Our first objective is path detection. Then the second objective is obstacle detection. UV sensor, HC-SR04 is used to detect the obstacle. It gives accurate detection even for small objects. UV sensor sends the signal through transmitter and when it is received by the receiver then obstacle is detected. When obstacle is detected, it has to be played by audio player and displayed on LCD.

The audio player used is APR33A3 which is a single chip, high quality record and play back solution. Its recording length is 170 to 680 second. It is interfaced to the ARM7 through the ULN. Maximum of 8 messages can be played by the audio player. This helps the marathoner by warning him about the obstacle.

Our third objective is voice recognition. The device used is voice recognizer module V2. This is a voice specific module. The predefined words can be stored and later recognized. The predefined words can include water, medicine, energy drink, food, cloth or snacks. These are placed in slots and a LED is placed on each slot. Whenever the marathoner calls out the predefined word, the corresponding LED placed on the slot glows. Thus, the marathoner can take the required items and practice well during his training period.

III. WORKING

The various components used and their implementation is as follows:

A. Microcontroller-ARM7 LPC2148

ARM stands for Advanced Risk Machine. Its main feature is low power consumption (LPC). There are mainly four registers that we have used:

- IODIR- to configure the pins as input or output
- IOPIN-to read the status of pin (connected to sensor)
- IOSET-to set a particular port pin 'high'
- IOCLR-to set a particular port pin 'low'.

The pins connected to sensor and voice recognizer are configured as input to the microcontroller whereas pins connecting the DC drivers, audio player, LEDs and LCD are configured as output from the microcontroller.

B. LCD

A 16x2 LCD is used which can display up to 32 characters. It has two registers:

1. Command register-stores the instructions that are given (like initializing, clearing the display etc.)
2. Data register-stores the message to be displayed (in the form of ASCII data).

The LCD is interfaced with microcontroller and helps in obstacle detection and voice recognition. As soon as an obstacle is detected by the sensor, a message saying *obstacle detected* is displayed. The voice recognized is also displayed on the LCD.

C. DC Motor and DC Driver

The DC geared motor is of high quality and low cost. The L298D motor driver provides proper matching between motor and LPC2148. A single driver can drive two motors at the same time.

Since this is a four wheeled robot and we are making use of four motors, two motors are simultaneously driven by a single driver.

D. Audio player

The APR33A3 device offers single-chip voice recording and playback. It is user friendly. It has two modes; record and play modes. A jumper is used to switch between the two modes. In record mode, the voice is recorded. Here a voice saying 'obstacle is detected' is recorded. In play mode, the recorded voice is played. Here, the recorded voice is played when an obstacle is detected.

ULN 2803 is used to interface the audio player to the microcontroller. It has 8 inputs and 8 outputs. It interfaces the audio player to ARM. Since it has 8 pins, maximum of 8 voices can be played. Here, whenever an obstacle is detected, the change is recognized by the ULN through IOPIN and hence played through the audio player.

E. UV Sensor

HC – SR04 provides 2cm to 40cm ranging accuracy. The sensor response is independent of the colour, structure and surface. It gives accurate detection even of small objects and can work in critical conditions such as dust and dirt.

This includes ultrasonic transmitter, receiver and control circuit. A high level triggering pulse is sent through the transmitter and an obstacle is said to be detected when a high level pulse is received back. The default value is '1' and it changes to '0' on detection of an obstacle. When an obstacle is detected, the change is recognized by ULN with the help of IOPIN and the corresponding message is played through the speaker and displayed on LCD.

The robot will take diversion on detection of an obstacle and will continue on the fixed path.

F. Voice Recognizer

Voice recognizer V2 module is a voice specific recognizer. It receives configuration commands or responds through serial port interface. This module can store up to 15 pieces of voice instruction.

Two steps should be followed. First, we need to train the module by using train button. Here, the predefined words are stored. The second step is recognition. The load button is pressed and the input (i.e., predefined words) given to the mike is received and recognized by the V2 module. This will be shown on the LCD screen and through LED.

The requirements of the marathoner such as water, medicine are placed inside the slots. Since these slots are closed and are difficult for the marathoner to recognize without opening them, LEDs will be placed on the slots. The marathoner needs will be stored as a predefined words in the recognizer and when it recognizes these words the robot pauses and the corresponding LED will glow. Thus, this helps in fulfilling the marathoner's needs while training.

IV. ALGORITHM AND FLOWCHART

Fig. 2 shows the flowchart for the working of the robot.

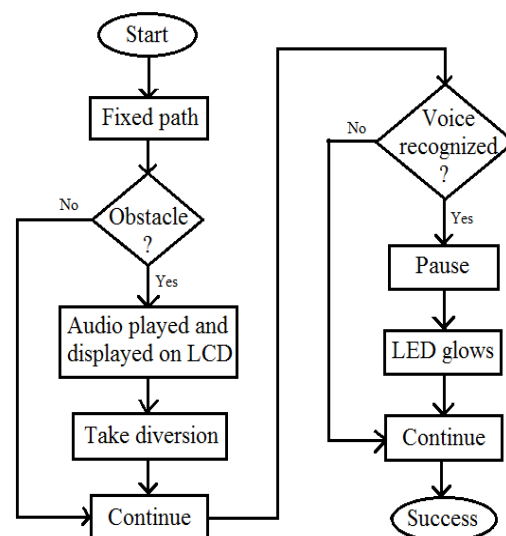


Fig. 2: Flowchart

The algorithm for the working of the robot is as follows:

- 1) There will be a fixed path provided for the robot to move. This helps the marathoner to keep track of the path specified for training.
- 2) The path can be square or circular which is initially defined in the program.
- 3) A major problem which is faced by many marathoners is obstacles along the path. Here UV sensor is used for obstacle detection.
- 4) The sensor detects the obstacle on the path and alerts the marathoner by announcing 'obstacle detected' through the audio player. The same message also will be displayed on LCD.
- 5) If obstacle is detected the robot takes diversion and continues its path.
- 6) The marathoner is frequently fatigued and requires refreshments during training.
- 7) The voice recognizer helps the marathoner with his needs. The predefined words such as 'water', 'energy drink' and 'medicine' can be stored in the voice recognizer. These items are placed in different slots.
- 8) If such predefined words are said by the marathoner, then voice recognizer will recognize these words. The robot will stop its movement and the corresponding LEDs placed on the slots will glow.
- 9) Thus, this helps the marathoner to take his requirements easily.

V. RESULTS

The robot moves along a fixed path. If there is obstacle on the path, UV sensor detects it and displays on the LCD. The output on the LCD when obstacle is detected is shown in Fig. 3.

The predefined words such as water or medicine is recognized by the voice recognizer and displayed on LCD. This is depicted in Fig. 4.



Fig. 3: Obstacle detection



Fig 4: Voice recognition



Fig. 5: Final output

VI. CONCLUSION

The proposed work intends to assist a marathoner while training. Marathoner service robot overcomes the difficulties faced by a marathoner during his training. Firstly, a fixed path is defined that is necessary for training. Secondly, the obstacle along the path is detected using sensors. Finally, the robot helps the runner by carrying his essential items required during training.

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