Arm Based Eyes-Free Interaction Model for Mobile Reading Devices

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Abstract: *Mobile reading devices that scan a document image and perform text to speech processing to make documents more accessible to those with visual impairments have been on the market for a few years. Interaction with these devices relies on the user's understanding of the device and its position in space. Typically, the user feedback is based on the device's position and the user must interpret how to compensate based on the feedback. Blind users of technology must rely heavily on auditory and tactile interfaces to provide a robust user experience. Unfortunately, a blind user's interaction with mobile devices is often limited due to the icons, buttons, and other sight-oriented expectations that designers build into such systems. The focus of this study is the development of an eyes-free interaction model that supports a voice user interface (VUI) of a mobile reading device for the blind. Research into eyes-free mobile reading devices has grown in recent years. This research has focused mainly on the image processing required by such a device, with a lower emphasis on the user interaction. In this paper, a model of a voice user interface (VUI) for a mobile reading device is presented. Three field studies with blind participants were conducted to develop and refine the model. A formal grammar is used to describe the VUI, and a stochastic Petri net was developed to model the complete user-device interaction. Evaluation and analysis of the user testing of a prototype led to empirically derived probabilities of grammar token usage for the commands that comprise the VUI.*

Keywords: ARM, Bluetooth, DC motor, Smart phone, Android application

1. Introduction

According to a recent report by the Jernigan Institute, fewer than 10% of the 1.3 million people who are legally blind in the United States are Braille readers. This is due to a number of factors including the lack of people able to teach braille, as well as the low number of Braille books that are available. Mobile reading devices that scan a document image and perform text to speech processing to make documents more accessible to those with visual impairments have been on the market for a few years. Interaction with these devices relies on the user's understanding of the device and its position in space. Typically, the user feedback is based on the device's position and the user must interpret how to compensate based on the feedback. (In this paper, we refer to people with a significant visual impairment that affects their ability to read as "blind.") Blind users of technology must rely heavily on auditory and tactile interfaces to provide a robust user experience. Unfortunately, a blind user's interaction with mobile devices is often limited due to the icons, buttons, and other sight-oriented expectations that designers build into such systems. The focus of this study is the development of an eyes-free interaction model that supports a voice user interface (VUI) of a mobile reading device for the blind. The development of this eyes-free model of interaction was based on iterating through a series of cognitive field studies.

The McNeese Framework suggests iterating through a series of six steps: goal identification, experimental field definition, knowledge acquisition, model representation, evaluation, and analysis. The goal of the work presented in this article is the development of a stochastic Petri net (SPN), for use in the application development of a VUI that supports a mobile reading device.
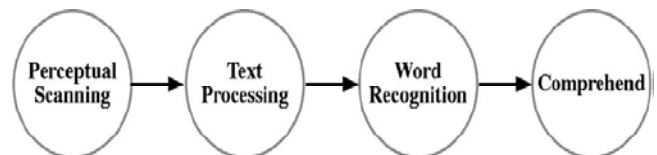

Figure 1: Simple model of reading
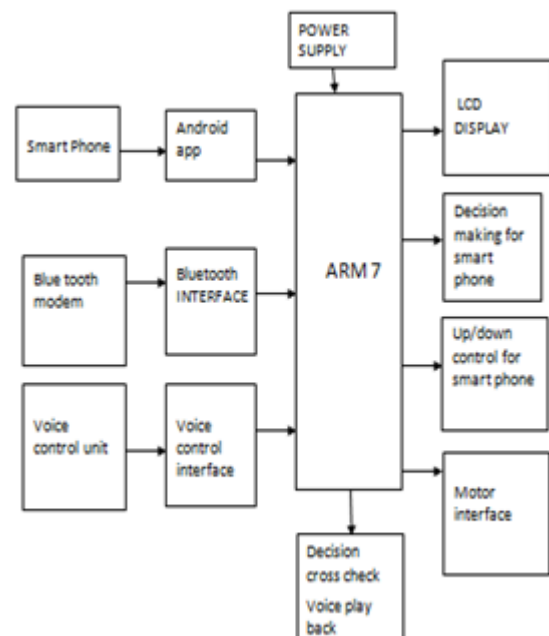
2. Proposed System

Figure 2: Block diagram of system

A. Android Application

In this scheme, each node with message searches for possible path nodes to copy its message. Hence, possible path nodes of a node are considered. Using NSS, each node having

message selects its path nodes to provide a sufficient level of end-to-end latency while examining its transmission effort. Here, it derives the CSS measure to permit CR-Networks nodes to decide which licensed channels should be used. The aim of CSS is to maximize spectrum utilization with minimum interference to primary system. Assume that there are M licensed channels with different bandwidth values and y denotes the bandwidth of channel c. Each CR-Networks node is also assumed to periodically sense a set of M licensed channels. Mi denotes the set including Ids of licensed channels that are periodically sensed by node i. suppose that channel c is periodically sensed by node i in each slot and channel c is idle during the time interval xcalled channel idle duration. Here, it use the product of channel bandwidth yand the channel idle duration x, tc = xy, as a metric to examine the channel idleness. Furthermore, failures in the sensing of primary users are assumed to cause the collisions among the transmissions of primary users and CR-Networks nodes.

B. Bluetooth

During the past two decades, the progress in microelectronics and VLSI technology drove the cost of many consumer electronic products down to an acceptable level for average people. Only in the 1st quarter of 2001, over 32.5 million PCs were sold. The number of cellular phones is predicted to reach 1 billion in 2005. With the increase of the number of these devices, so does the need of connecting them together. Today numerous kinds of special cables are used for interconnection. It's cumbersome, not interchangeable and expensive. Bluetooth is devised to replace these cables. Bluetooth is a low cost, low power, radio frequency technology for short-range communications. It can be used to replace the cables connecting portable/fixed electronic devices, build ad-hoc networks or provide data/voice access points.
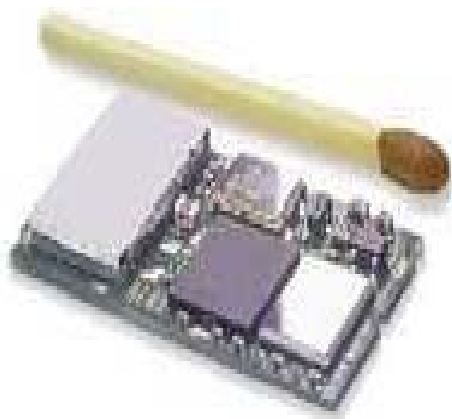
Figure 3: A Bluetooth Module

C. L293D MOTOR

The Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoids, DC and stepping motors) and switching power transistors. To simplify use as two bridges each pair of channels is equipped with an enable input. A separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included. This device is suitable for use in switching applications at frequencies up to 5 kHz. The L293D is assembled in a 16 lead plastic package which has 4 center pins connected together and used for heat sinking The L293D is assembled in a 20 lead surface mount which has 8 center pins connected together and used for heat sinking. L293D is a dual *H-bridge* motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.
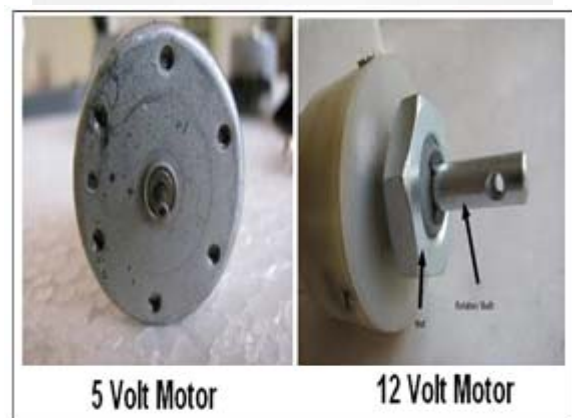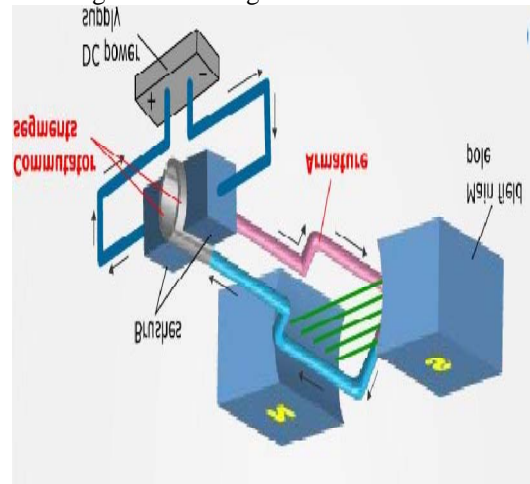
Figure 4: L293D Motor driver

L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively. Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.
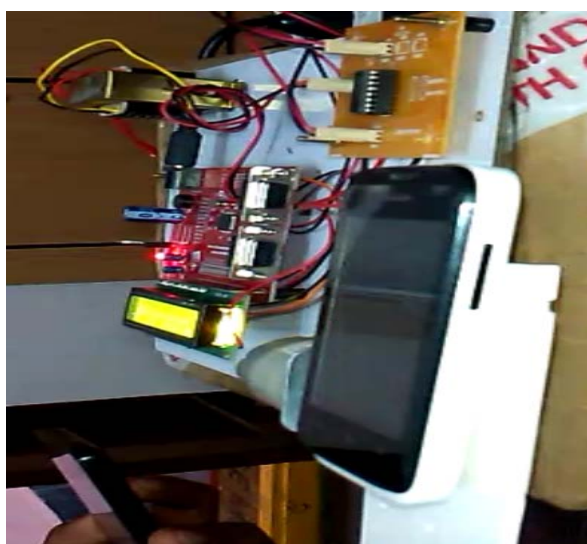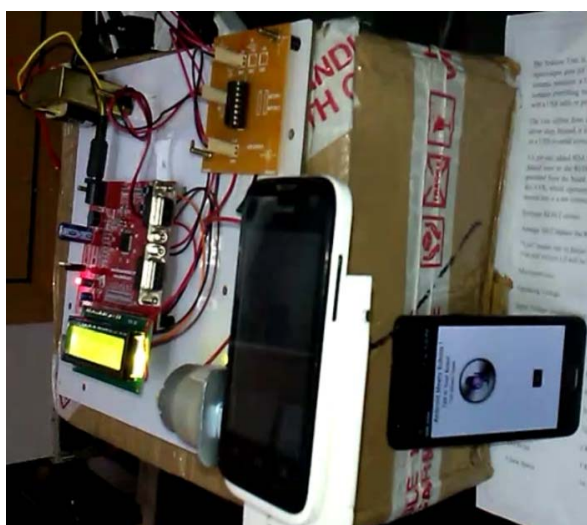
3. Results

free further with a Rasmussen decision ladder. The interaction details emerged further with a hierarchical task analysis of the interaction. The task analysis was then used to develop a model and a grammar for the VUI. This grammar was then developed and evaluated by visually impaired human subjects. Analysis of the evaluation results led to the development of a SPN. Further evaluation and analysis led to empirically derived probabilities of grammar token usage for the commands that comprise the VUI. This SPN was evaluated and refined further, culminating in a proposed model that could be used to guide the implementation of a VUI for mobile reading devices.

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4. Future Scope and Conclusion

The development of a VUI for a blind user in the use of mobile reading devices that supports regression, find-ability, and provides spatial cues was described in this paper. The model development began with a generic model of eyes-free navigation, which was then modified to accommodate eyes-

Paper ID: OCT14386

1645

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