INVESTIGATION OF A SMARTPHONE-BASED UNIVERSAL CONTROLLER FRAMEWORK FOR EMBEDDED SYSTEMS

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PREVIEW

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By

Yi Jin

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The thesis of Yi Jin is approved.

Yutao He

Jane Dong

Fereydoun Daneshgaran, Department & Committee Chair

California State University, Los Angeles

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ABSTRACT

Investigation of A Smartphone-based Universal Controller Framework for Embedded Systems

By

Yi Jin

The research presented in this thesis investigates a smartphone-based framework for universal remote control. Taking the toy remote control car as a case study, Universal Controller (UniC) framework is developed, implemented, and tested. UniC uses an Android phone as the main controller, Arduino hardware as an adapter to interface with the control target, and Bluetooth as the wireless communication. It is shown the feasibility and advantages of smartphone-based controller in comparison to the traditional remote control approach.

Keywords: Universal Remote Controller, Smartphone, Android, Arduino, Bluetooth

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CHAPTER 1

Introduction

Motivation

Wireless remote control is a proven technology that greatly eases our daily life and brings the enjoyment. Taking the TV remote control as an example, we can simply sit on the sofa and switch to different channel without standing up to reach out the TV. It not only increases the fun but also gives vitality to the toys. It makes children's toys to become transforming objects of numerous adults' technology enthusiasts. Therefore, almost all electronic appliances have the remote control nowadays. Along with it, however, it also brings unwanted problems. For example, if one needs to control his third TV set in his family, he will have to select the right remote control for one TV set. It is commonly the case that one cannot find the right remote control quickly. As a result, when number of remote control increases, picking a right one becomes a problem.

The remote control itself belongs to physical electronic products with production costs. It requires lots of manpower and material for design, processing, assembly, transportation and storage.

The traditional remote control is made by plastic with low quality and cheap organic coating to reduce the costs. The toxic substances would be volatilized and fallen off. Furthermore, all plastic is non-biodegradable. The current handling process will be landfill, incineration, composting. The incineration equipments are expensive and require flame retardant; otherwise it will lead to secondary pollution. Composting using household garbage will make the soil harden and groundwater with bad quality. The metal for production is silicon and quartz belongs to natural resources.

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The research presented in this thesis is to change a physical remote control to a software app on a smart phone to implement the remote control of different household appliances by simply switching to the different program of a smart phone to overcome the problems described before. As a result, it reduces the considerable costs.

Taking the toy car as an example, the toy car with remote control of Android smart phone in this study provides much more features without the same form factor. It also enables users to share the perspective of remote control car and augmented reality and experience occurred in a racing game.

Objectives

The study described in this this is to develop a smartphone-based framework for universal remote control, and implement a proof-of-concept prototype. In particular, UniC (Universal Controller) is composed of an Android smartphone, an Arduino main board, and an L293D/298N chip-based adapter for toy car remote control.

Related Work

Many implementations have been performed. As shown in Figures 1.1 and 1.2, Jonathan Rico's work [15] uses Armarino software to provide 4-direction control.

Figure 1.1. Jonathan Rico's Demonstration 1

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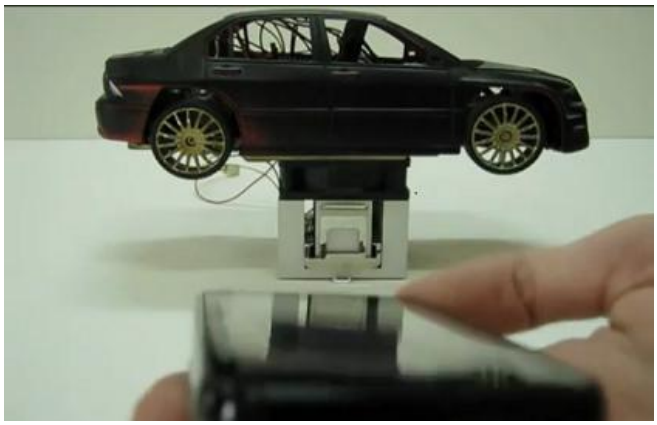

Figure 1.2. Jonathan Rico's Demonstration 2

Figure 1.3. Android Remote Control Product

As shown in Figure 1.3, the remote control toy once appeared in the Movie of *3 Idiots* has become the commodity of mobile phone remote control.

Figure 1.4. The Works of Blair Kelly

Blair Kelly's work in [11] uses gamepad by the camera on the small car. It is the same as playing a video game on a family TV set. Implemented with Arduino Wifly Shield, it is

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expensive as a video transmission media. The combined cost of one camera, one Antenna, and a Receiver is at least $500.

It is discovered that it is lack of a general framework that allows to be reused and adapted to different control targets with minimal development cost. This is what the thesis is trying to resolve.

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Contributions of this Thesis

The UniC framework developed in this thesis has the following advantages over existing Arduino mobile phone-based remote control cars:

1. A unified framework based on Android smartphones and open-source Arduino hardware allows easy adaption and low-cost solution for various remote control targets.
2. As its overall welding circuit, it has stability of running and operation; besides, the working voltage of the coordination of each part is considered in details.
3. The efficient function partitioning on hardware and software allows a balance between flexibility and performance.
4. The division of hardware programming for motor control makes better operational feeling and logicality.
5. The operation interface of users and variety of functions for software programming are very rare in current individual works.
6. Variety of functional structure and flexible grasp of various kinds of sensors for hardware are very rare in current individual works.
7. One innovation is the stability of text sending and receiving between the Bluetooth connection between Smartphone and Arduino.
8. Selection of better hardware that achieves better heat dissipation to assure more stable voltage and more durable operation.
9. Considering all kinds of personal works for Arduino remote control, the stability and functional diversity of my works are in leading level.

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