MIX MASTERS

Remote Controlled KitchenAid Mixer for the Clients at ADEC

High Level Design

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1 Introduction

Technology today is produced for a mass market. Machines have been created to manufacture hundreds of thousands of goods in specific, predefined ways. As a result, consumer products are often created with the “average” user in mind. In some cases, however, this may make the product more difficult for other users, such as those with disabilities. Since it’s impossible to make a product that satisfies *everyone*, these other users may need to look into other technologies — assistive technologies. Assistive technologies refer to items or pieces of equipment that have been bought or modified for use by individuals with disabilities.

We have decided to work with ADEC, a local community for the disabled that works with them to improve their lives. This includes helping them become more independent and employing them in various day tasks to give them meaningful work. Harnessing assistive technologies allows users to achieve the independence ADEC is hoping to instill. This area, however, is still growing and there are some devices that have not yet been made adaptive, limiting the freedom of the disabled community.

2 Problem Statement and Proposed Solution

Aside from researching and developing adaptive technologies, ADEC offers a variety of activities for those with disabilities. One such activity is making dog biscuits, which involves the use of a KitchenAid mixer. In order to promote a stronger sense of independence for these individuals, ADEC hopes to implement ways to make this process easier and more accessible. Our goal is to modify and improve the mixer used in this process.

To do so, the speed control of the mixer will be changed such that only speeds one through four will be used, as the biscuit making process does not require any faster speeds. Additionally, the speed will no longer be changed with the slider on the body of the mixer, but with a remote separate from the mixer with buttons for all speeds needed, allowing for easier control.

3 System Requirements

Our system will be required to have a certain level of embedded intelligence: it needs to be able to read the remote battery for the user and indicate whether it needs to be replaced. This is of utmost importance, as a mixer that will not turn off represents great danger to the consumer.. Furthermore, it needs some safety features, such as the ability to sense if a hand is approaching the mixing bowl. It is important that the mixer recognizes this and cuts the power to the motor, stopping it before damage is done.

Furthermore, our product needs power in order to operate. The remote will be battery powered, having a comparable lifetime to a TV remote. To accomplish this a couple of basic AA batteries are all that are necessary. On the other end, the motor circuit will be controlled by the already existing wall plug, and everything else in that circuit will just tap into that power. Two devices need to be able to interact with each other via infrared. We plan on using I2C to accomplish this.

In terms of user interfaces, users should not be interacting with the mixer after installation and all interaction will occur through the remote. The remote will have buttons representing each of the different speeds. These buttons will light up to show that they have been pressed, and a light will be visible on the mixer side to show that the signal has been received. This will go a long way to keeping the clients calm and allowing them to easily use the device. Meanwhile, indicators on the device will show all relevant information, such as if the device is on and the status of the battery which will become more evident if the battery drops below a certain threshold.

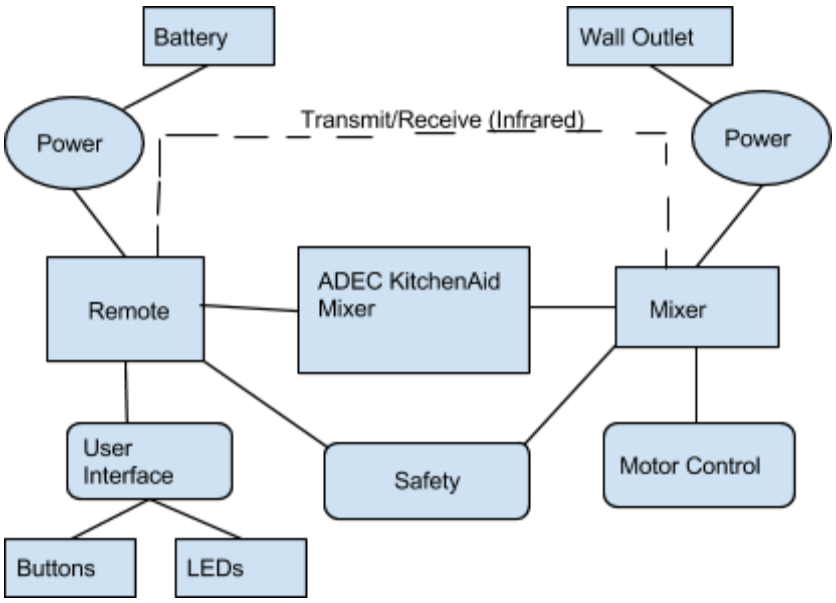
Once the mixer is modified, installing the machine is as simple as plugging the mixer into the wall. If the remote has the appropriate batteries,the mixer works by turning on the remote and pressing the speed controls.

Since we will be working with large currents and high voltages we will need to be sure to be able to stop the motor at a moment’s notice.

When it comes to size and weight, we will want the remote to be small (portable, but not necessarily handheld) and relatively light for the convenience of the customer. However, only light materials are necessary, with no major components necessary on the remote side. On the mixer side, the extra parts need to be contained within the mixer, but excess weight is of no concern.

4 System Block Diagram

4.1 Overall System:



This block diagram above displays the various subsystems for the mixer. The system is split into two different devices: the mixer itself and the remote control. They are connected by an infrared transmitter and receiver. Both devices have a power component. The remote has a user interface component including buttons for speed selection and lights and icons to show various things to the user.

4.2 Subsystem and Interface Requirements:

The infrared system involves a transmitter on the remote side and a receiver on the motor side. The system needs to be able to communicate at distances of at least 10 feet.

The remote control needs to have the transmitter for the IR system. On the control needs to be 4 buttons, one for each of the speed controls as well as a on/off control, either a switch or button. Turning off the power of the remote should shut off the power of the mixer as well. Pressing a button will light it up to ensure that it is

obvious that the button is being pressed and to indicate that a signal is being sent. Furthermore, the remote should be run on commercially available batteries, and should indicate to the user how much battery life is left in the batteries.

The mixer side of the system must have the receiver of the IR system. It will receive that signal input and control the motor to the corresponding speed using the TRIAC. The mixer needs to be able to tell if the motor is spinning too fast and shut off the power to avoid accidents. Furthermore, in case the batteries run out of power, there will be manual shutoff mechanism to cut the power to the mixer.

The speed control circuit, as part of the mixer, needs to intake the signal from receiver and control the mixer into one of four speeds or turn the motor off.

4.3 Future Enhancement Requirements

As mentioned before, the primary goal of our project is to effectively control the speed of the mixer with a separate remote. Taking into account the inner systems of the mixer, which we are not familiar with, some enhancement processes might require advanced technologies that are not affordable to us. Thus, we plan to primarily focus our attention on building a relatively straightforward board with the basic components (TRIACs, capacitors, microcontroller, etc.) and later develop our system to incorporate other aspects of the biscuit making process that could enable our clients to be more independent and at ease. Among the features that won't be part of our initial release of our product, the following can be listed:

- Effectively measure and pour the ingredients into the mixer
  We intend to make the process much easier and accessible for our clients by minimizing the potential sources of confusion or inconsistencies in getting the right amount of ingredients for preparation. We are hoping to potentially create well-labeled easy-pour cups with a sensor attached to determine the quantity of the different elements used in the mixture.
- Camera attached to the mixer to monitor dough consistency and for safety measures.
  By safety measures, we mean that the camera should be smart enough to notice unexpected events, such as a hand getting into the mixer and effectively communicate with our device to interrupt the system.
- Signal to indicate when mixture is completed, which could be accomplished by activating a light on the remote.

With all these enhancement systems, we believe our product will be more user-friendly.

5 High Level Design Decisions

- IR

  The infrared subsystem will use infrared signals to set the speed of the mixer. To do so, IR transceivers, such as Maxim Integrated transceiver MAX3120CSA+, or microcontrollers with embedded IR, such as Maxim Integrated microcontroller MAXQ622G-0000+, will be needed to send and receive signals. The system will also require I2C or SPI to send and receive, which this microcontroller is capable of doing.

- Remote Control

  The remote will provide an interface for the user to set the speed of the mixer, as well as turn the mixer off and on. The remote will make use of individual buttons to set the speed and either a button or switch to turn the mixer off. The current speed of the mixer and a power light will be indicated by LEDs. The remote will be powered by batteries; a battery level indicator will be implemented using LEDs. The remote will house the board of the device, and will need to be large enough to do so.

- Mixer

  The mixer will be modified such that it will be able to receive IR signals, using a transceiver as mentioned above, and set the speed of the motor to the appropriate level based on the signal received. The speed control will be accomplished by TRIACs. The IR will receive a signal, and determine voltage needed to run the TRIAC at the desired level, in order to change the speed of the mixer. An external switch will also be used in order to manually shut off the mixer if necessary.

6 Open Questions

For our project, there are few things that we are not sure how to do, such as:

· How to effectively determine when the dough is well mixed

We discuss potential methods of monitoring the consistency of the dough, such as using a sensor to check the viscosity of our mixture, but we are still uncertain of the physics as well as mechanisms to implement such function

· Use wireless technology to properly communicate with our device

We don't really know how the infrared system operates and how to use that technology to interconnect our system components.

· Ensure that users do not misuse device (prevent unintended acts)

We would like to make the overall process very safe for our clients. However, we are unsure how to effectively implement safety measures to prevent any potential harm.

· Effective ways to measure ingredients in order to minimize waste

As pointed out in the future enhancement requirement section, we are hoping to make the measuring and pouring processes as much easier as possible for our clients, but we are still looking for simple and inexpensive ways to operate these functions, with minimal technology involved.

7 Major Component Costs

KitchenAid Mixer = $200 - $300. Most of them, however, are around $250.
Microcontroller Board = $50.
Triac = $3
4 Buttons = $10 - $20
LEDs = $5
Transmitter/Receiver = $2 - $8, each.
Container for remote = $25

TOTAL (high) = $300 + $50 + $3 + $20 + $5 + $16 + $25= $419

8 Conclusions

Designing and building this mixer on a tight budget presents significant engineering challenges. We must learn to control the speed of the mixer consistently, interface the mixer with external buttons, and send the signal over the air. This will just get the basic functionality. However, there are also human factors as well. Designing an understandable interface that is both usable and pleasant to use will pose some constraints on our inputs and outputs of our microcontroller. Considerations for safety must also be a factor and will affect certain features that are implemented. We hope that this mixer will assist ADEC in their efforts to bring purpose and joy to their clients' lives.

Assistive Technology:
http://en.wikipedia.org/wiki/Assistive_technology
http://www.adecinc.com/our-services/assistive-technology

ADEC:
http://www.adecinc.com/who-we-are

Transmitter/Receivers:
http://www.digikey.com/product-search/en?mpart=ATA8404C-6DQY-66&vendor=313
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https://www.youtube.com/watch?v=tyQ-BM7sXy0
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