

**ECE445 Project Proposal**  
**Fingerprint Protected Voting Machine**  
**Team 68: Ashwin Dandapani (ashwind2),**  
**Brennan Hartigan (bah4),**  
**Jeremiah Kennedy (jck5)**  
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**TA: Dean Biskup**

# **1. Introduction**

## **1.1 Objective**

As the 2020 election brought upon many questions with regards to voter fraud [9], we felt our project would be best served to attempt to help or fix this problem. We believe the best way to uniquely identify voters and prevent voters from revoting is to use each voter's fingerprint. Since each fingerprint is unique to a person, there will not be the ability to fake your eligibility or your name when voting.

Our plan is to utilize fingerprint identification to confirm that a voter has not voted previously to keep the voting fair. We will design and create a scrolling device that allows the voter to scroll through the options and select the candidate they decide on. After this, they will receive a receipt to confirm that they had voted.

## **1.2 Background**

To further give context on the need for this system, our group did research with regards to the 2020 presidential election and all of the claims about potential voter fraud, a lot coming via Trump's tweets as well as his campaign. This is something we feel can be completely fixed with voter identification through fingerprints. According to the BBC, the Trump campaign mentioned "voter turnout in some areas was higher than 100%, an outcome known as an 'overvote'" [9].

An overvote would not be possible if after a uniquely identified fingerprint has a boolean true saying that the person has in fact voted. It is understood that this election was unique because mail-in votes were more prominent due to COVID-19, but we feel this would be a safe alternative to the current system for voting.

## 1.3 Physical Design

Our project will have a fingerprint scanner that is attached to a control panel that allows for scrolling left, right, up, down, and a select button to choose the vote. This will connect to a monitor screen to allow for the voter to see who they can select from and then click on the option. The monitor will also tell them if they are eligible to vote after scanning their fingerprint.

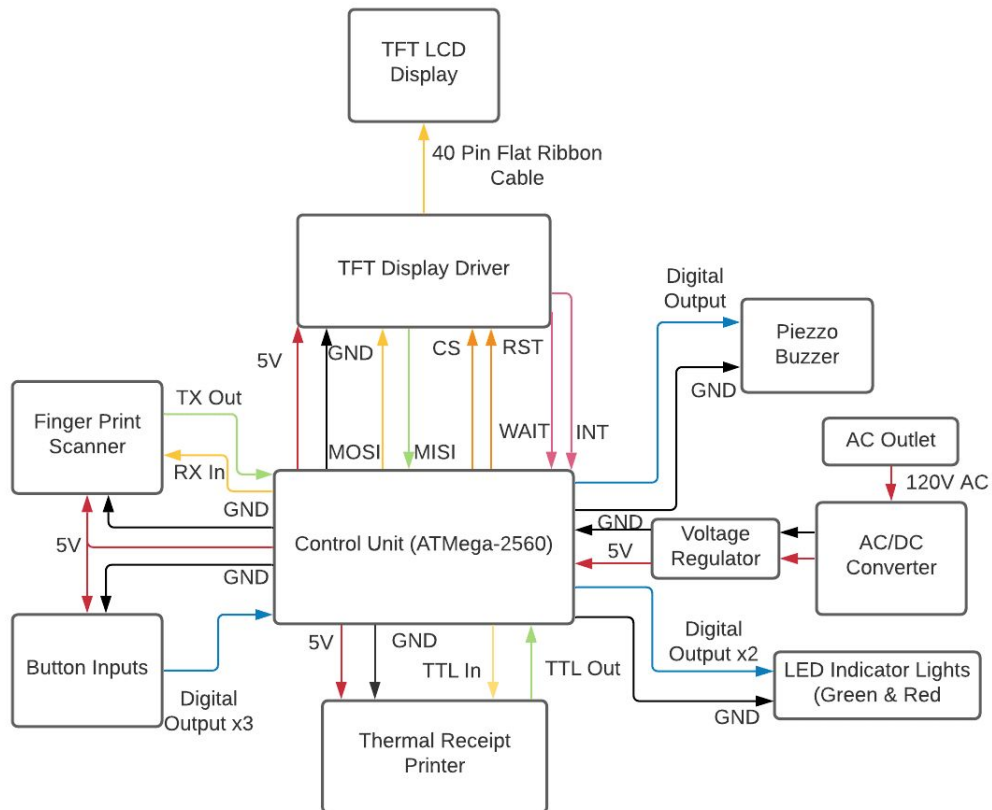
The physical envisioning of this system would look something like an arcade machine, with the buttons and fingerprint scanner mounted to a piece of wood parallel to a table, and the screen mounted on a connecting piece of wood perpendicular to the table. All electronics would be housed on the interior side of the wooden panels, out of sight from the user.

## 1.4 High-level Requirements

- Voter can scan their fingerprint and successfully make a vote. If the fingerprint did not have a match after three tries, then the voter is rejected.
- Interface and controller are easy to use and understand in order to cast a vote on a candidate as well as being able to print out a receipt with proof of voting. This will be determined with the amount of time it takes to go from the initial fingerprint scan to the final printing of the voting receipt.
- Voter will be able to receive feedback through the LEDs, speaker, and receipt printer as to whether their vote went through as well as to confirm which candidate they voted for.

## 2. Design

### Block Diagram



## **2.1 Power Supply**

A power supply is required to keep the voting machine and all hardware peripherals running during use.

### **2.1.1 AC to DC converter**

An AC to DC power supply converter is needed in order to allow the system to be plugged into a 120V AC standard wall plug, and convert the power to DC voltage so the hardware in this project can be powered correctly. The AC to DC converter will also need to step down the voltage to 12V so it can be handled by the voltage regulators.

*Requirement: Must be able to convert AC voltage to DC voltage, and step down the voltage to 12V so it can be processed by voltage regulator ICs.*

### **2.1.2 Voltage Regulator**

These ICs will supply the necessary 3.3V and 5V to the hardware in this project. These ICs will need to be able to handle incoming DC voltage from the AC to DC converter [2].

*Requirement: The voltage regulator ICs must be able to handle incoming 12V DC voltage from the wall.*

## **2.2 Control Unit**

A control unit will handle all inputs from people (selection buttons), sensors (fingerprint reader), and process the voter identification and voter selection data to be displayed on a screen, with feedback given to the user through LEDs, a buzzer, and a receipt printer in this system.

### **2.2.1 Microcontroller**

The microcontroller, chosen to be an ATmega2560 [1] will handle all user input and output for the voting machine. These input and output signals sent to the various other devices in the system will be a variety of UART, digital, and PWM signals.

*Requirement: The microcontroller must be able to simultaneously process input data from the fingerprint reader, display voting instructions on the screen, process voter input from the button controller, and send signals to control various outputs to the LEDs, buzzer, and receipt printer*

### **2.2.2 Input Controller Device**

An input controller device will be made up of four buttons: two for scrolling up and down, one to advance the display/enter a selection, and the fourth used for going back in the selection process. These buttons will communicate with the microcontroller via digital signals.

*Requirement 1: The buttons must be easily pressable, with an operating force of 0.6N*

*Requirement 2: The buttons should be prominently displayed and easily accessible.*

*They will be the main forefront of the physical design.*

*Requirement 2: The buttons should not have input delay exceeding 50ms*

## **2.3 Fingerprint Scanner**

The fingerprint scanner [6] will have the ability to read in a user's fingerprint, and send data to the microcontroller via UART to compare with existing fingerprint data.

*Requirement 1: Less than 1 second fingerprint image acquisition time*

*Requirement 2: Can match each fingerprint on a 1:1 basis if there is existing fingerprint data*

*Requirement 3: Can accurately produce a fingerprint image within 3 user attempts. If there is an unsuccessful attempt, the screen will display a message asking the user to wipe or clean their finger, as dirt or sweat may be impeding the scanner from reading the fingerprint.*

## **2.4 LCD Display**

An LCD display will be the main user interface of the machine. It will provide instructions, show messages granting or denying access to the system, and show candidate choices for a voter to make their selection.

### **2.4.1 4.3" 40-Pin TFT Display**

This is the LCD display that has been chosen for use in this project [3]. It will communicate data on the machine's with the user, and will be the main output source for the overall UI.

*Requirement 1: The display needs to be constantly refreshed at a 60hz refresh rate*

*Requirement 2: The display will need 5-9V and 125-150mA input to maintain its backlight, so it is easy for users to read.*

## **2.4.2 TFT Display Driver Board**

A RA8875 driver board for 40-pin TFT touch displays [4] will be used as the driver for the LCD display. This will allow the display to be refreshed at 60hz, and adjust the power to the display, as the display requires a 5-9V and 125-150mA input. The driver board will maintain the input power to the screen, and handle the screen RAM and timing requirements in the background.

*Requirement: This driver will communicate with the microcontroller via SPI.*

## **2.5 Output Hardware**

Output hardware devices will help to improve the overall user experience, as well as enhance the project with audio and visual output.

### **2.5.1 Buzzer**

A Piezo buzzer, model PS1240 [7] will be used to communicate to the user that their access has been denied. This will be communicated from the microcontroller via a digital signal.

*Requirement: Output frequency should be at a minimum 2KHz, and maximum 4KHz*

### **2.5.2 LEDs**

LEDs will communicate “access granted” with a green LED illuminating, and “access denied” with a red LED illuminating.

*Requirement 1: Turn on within 10ms of access denied/granted*

*Requirement 2: Remain RED until access is granted, remain GREEN once access has been granted until the user is finished voting. The user is finished voting when their vote has been cast and the receipt printer prints out a record of their vote.*

## **2.6 Mini Thermal Receipt Printer**

A mini thermal receipt printer [5] will print the voter’s selection on thermal paper, to be placed in a secure ballot box and counted and tallied at the end of the voting process. It will receive data from the microcontroller via digital signal.

*Requirement: Accurately print a voter’s selection onto thermal paper with a resolution of 8 dots per millimeter, 384 dots per line.*

## **2.7 Risk Analysis**

The fingerprint scanner is a significant risk to the completion of this project. In order for this project to successfully demonstrate its intended purpose of being a safe, secure method of voting that avoids the use of a physical “voter ID,” the fingerprint scanner will need to be able to read fingerprints, and compare the fingerprint image with the pre-existing fingerprints already in its memory. This will have to be done with incredibly high accuracy, but will also account for a person’s finger being sweaty or dirty. If their first attempt fails, the screen will output a message for the user to clean off their finger and try again, for up to two more attempts. This is a reasonable amount of user attempts, and is within the sensor’s ability to accurately capture the fingerprint image.

## **3. Ethics And Safety**

One of the biggest ethical issues facing this project is the possibility of a person’s name being linked to their ballot submission. In person ballots cast in the US have to follow a style of ballot called the “Australian Ballot.” The qualifications of an “Australian Ballot” means they must be printed by the government, contain all candidates, distributed at a polling place and marked in secret [10]. Therefore, our system must protect the privacy of voters to abide by state laws in the US. The machine protects against this by not storing the persons votes locally on the machine and only printing out the results on the receipt printer. This is done in order to abide by article 1, section 1 of the IEEE code of ethics which states members of IEEE are to uphold and “protect the privacy of others”<sup>[8]</sup> and abide by state laws [8]. Once someone has voted, we will not store who they have voted for since this is a privacy concern, but simply print out a receipt with the voting results to be dropped in the “ballot box.” People who don’t have their fingerprints registered with the government would have the option to register them for free when they register to vote. If they would prefer to use traditional forms of ID (drivers license, state ID, passport, etc) they can choose to do so.

In terms of safety, there is risk of electrical shock when dealing with electrical components. To eliminate this risk, all of the components will be contained in a wooden (or some other kind of material) casing. Another potential safety issue is if the microcontroller overheats and causes a fire. To address this problem, an appropriate sized heat sink will be installed on the microcontroller to dissipate the thermal energy.



## **References**

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