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1 Block Diagram:

![Block Diagram of the system]

*Figure 1 Block Diagram of the system*

2 Schematic:

The power switching circuit is responsible for determining which power source is used by the system. When the main power (12V) is off, the battery (9V) is used.
3 Block Description:

- **NFC Reader (PN532 RFID Module):**
  The NFC module is responsible for reading the phone NFC identifier and relaying that information to the ATmega via High Speed Universal Asynchronous Receiver/Transmitter (HSU). This identification information is used to decide whether or not to open the lock. The NFC module is powered by a 5v rail from the power block.

4 Calculation:

We wanted to calculate the value of the capacitor needed to provide backup power for the system when the power goes out. To do this, we used the formula $C\Delta V = I\Delta t$, where we are solving for $C$.

$$C = \frac{I\Delta t}{\Delta V}$$
The $\Delta t$ value is how long the capacitor will have to power the circuit, which we estimated based on the switching time of a diode is 400 ns. The $\Delta V$ in this equation is the drop in voltage that we are willing to allow, which in our case is 0.3 V because that is the lowest voltage tolerance of any component in our system. Finally, we needed to know how much current the load would draw, which was calculated by summing the current draw of each component in our design based on the datasheet. From our analysis, we found the following values:

$\Delta V = 0.3$ volts

$\Delta t = 400$ ns

$I = 0.393$ A

And therefore we found:

$$C = \frac{I \Delta t}{\Delta V} = \frac{0.393 \times 400}{0.3} = 524 \text{ nF}$$

5 Simulation:

This simulation displays the output of the switching diodes for a voltage sweep, demonstrating that once the wall voltage transitions back to normal after a power loss, the output voltage goes back to normal from a steady state voltage.
6 Requirements and Verification:

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Verification</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFC reader: the maximum reading distance should be 7cm</td>
<td>Load and run the test code to display data read by the NFC on the console. Slowly move the phone towards the reader until a stable reading is acquired. Measure the distance from the NFC reader to the phone.</td>
<td>5</td>
</tr>
</tbody>
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7 Safety:
- The module contains a Lithium battery. Do not expose the module to extreme heat source.
- When connecting the wall adapter to an outlet, avoid having dangling wires, especially one that may get stuck at the chink in the door.

8 References:

