Low Carbon Footprint Electric Lawn Mower

Functional Requirements List and
Performance Specifications

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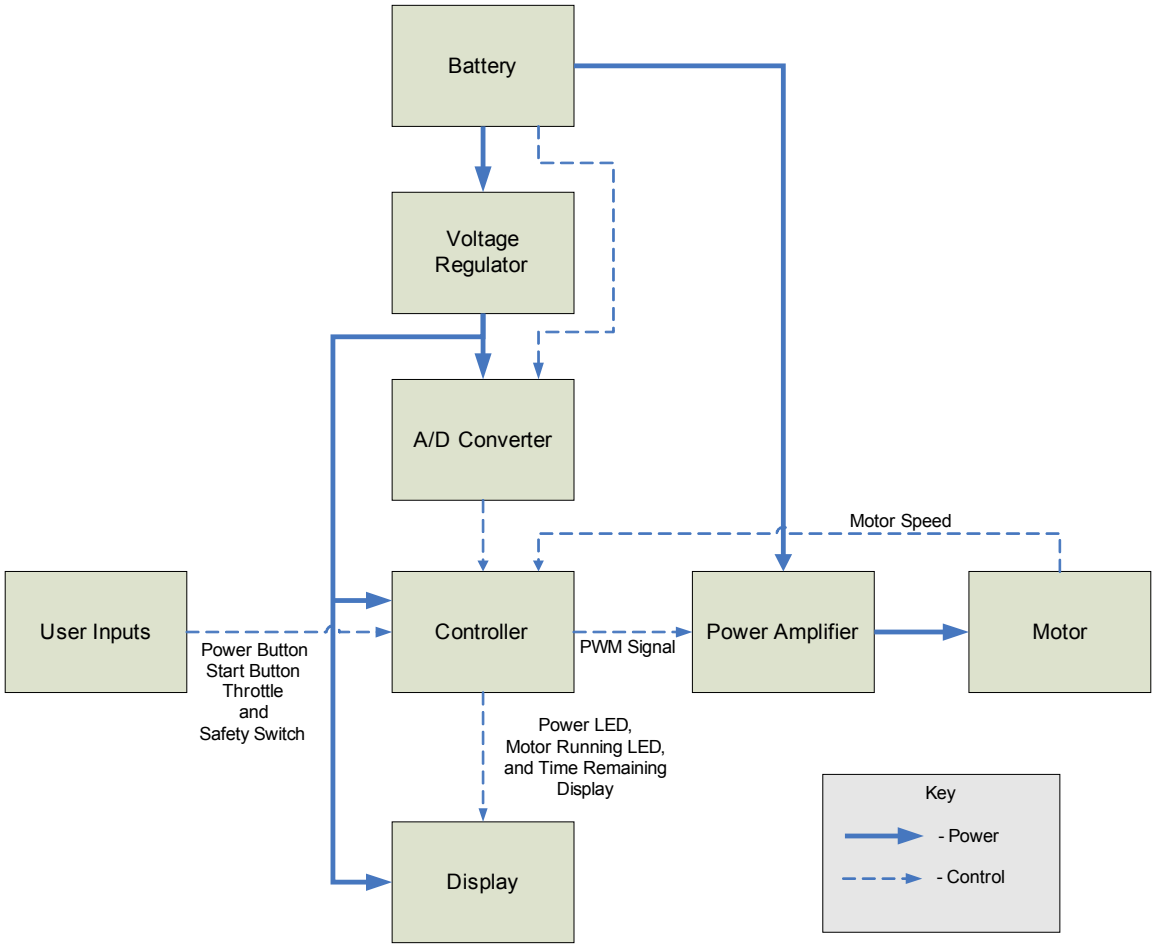
Environmental pollution is becoming more of a problem. A major contributor to this pollution is the use of gasoline-powered lawn mowers[1]. Our overall project goal will be to design a lawn mower that will be a solution to this problem. The project will consist of two separate systems: a battery-powered lawn mower and a photovoltaic system to charge the battery. Both systems will be microcontroller based. The mower will use a microcontroller to control the speed of the cutting blade and display the charge status of the battery. The charger will use a microcontroller to control the charging algorithm for the battery. In addition to this, the charger will include an AC backup in case of an extended period of cloudy weather.

Fig. 1 – Lawn Mower Block Diagram



Lawnmower Subsystem Breakdown

The lawnmower shall be a push-type mower and shall have an 18 inch cutting blade.

Battery: The battery powering the mower shall be two 12 volt batteries connected in a series configuration. The capacity of each battery shall be chosen so that the mower is able to mow a 10000 sq. ft. yard in one hour. The batteries shall be able to be removed from the lawnmower

Voltage Regulator: The voltage regulator shall have an input voltage of 24VDC and an output voltage that shall meet the requirements to power the various components (to be determined).
A/D Converter: The A/D converter shall have 8-bit resolution and have a range of at least 0-24 volts.

Controller: The controller shall be used to start and stop the motor, control the speed of the motor, and control the display. The controller shall utilize closed-loop methods to keep the speed of the motor shaft relatively constant. The signal that is output to the H-bridge shall be a PWM signal with a frequency of at least 20 kHz, but less than 100 kHz. The controller shall also monitor the current draw of the motor for over-current protection. The maximum current is to be determined.

User Inputs: The user inputs shall consist of a power button to turn the controller on/off, a start button to start the mower, a throttle switch to vary the speed of the mower blade, and a safety switch to stop the mower. The motor shall only spin if the safety switch is engaged.

Display: The display shall consist of one power LED, an LED to alert the user that the blade is spinning and at least two seven-segment displays to show how much time is left until the battery is fully discharged. It shall also consist of a voltmeter to display the battery voltage and an ammeter to show the current draw of the motor. The range and accuracy of these two meters will be determined later.

H-Bridge: The H-bridge amplifier shall have the capabilities to power the motor (to be determined). It shall have a maximum output voltage of 24VDC.

Motor: The motor driving the blade shall have an input voltage of 24V DC and have enough power to spin an 18 inch blade at a speed that will cut grass (to be determined).

Fig. 2 – Mower Controller Flow Chart

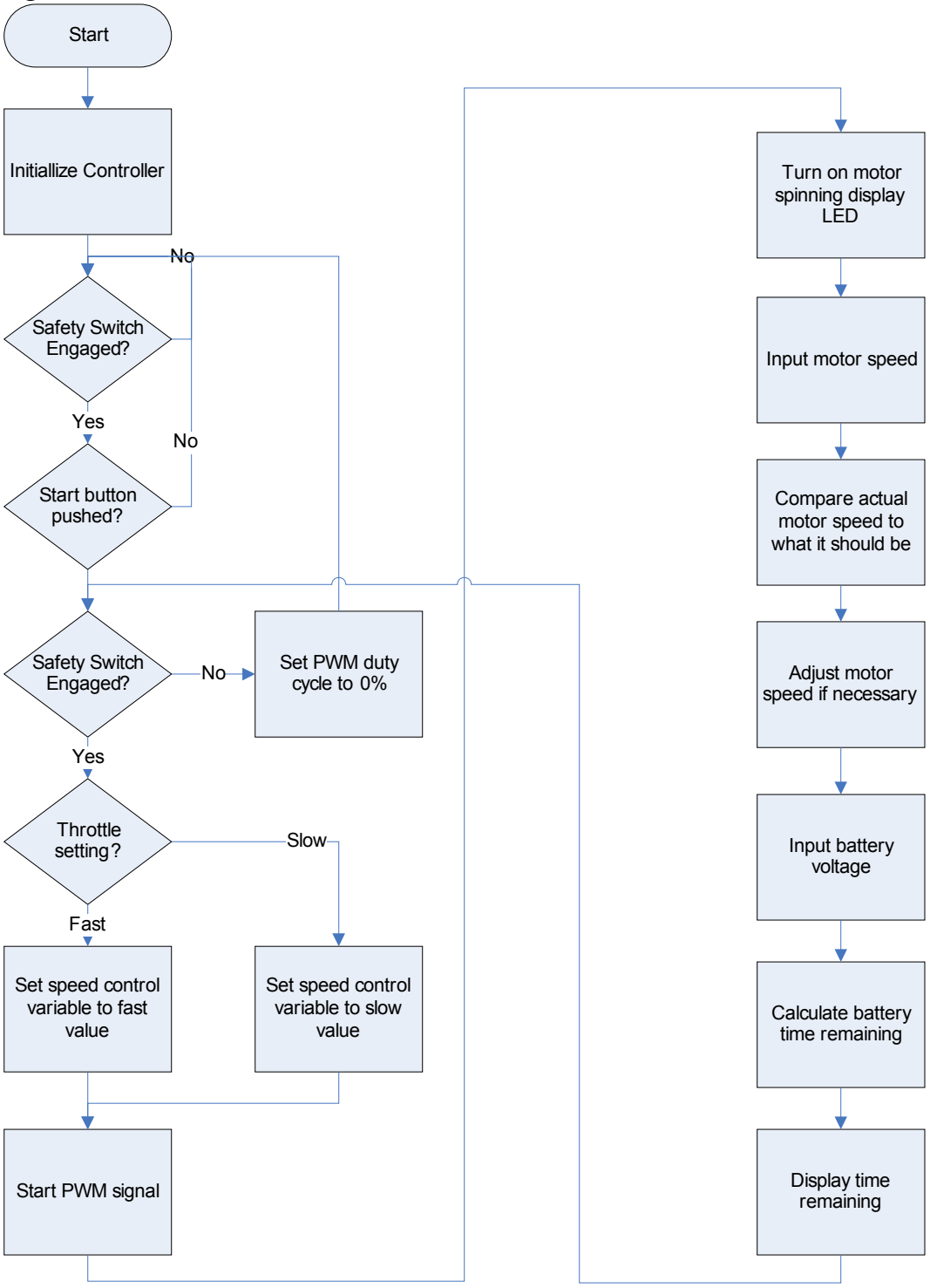
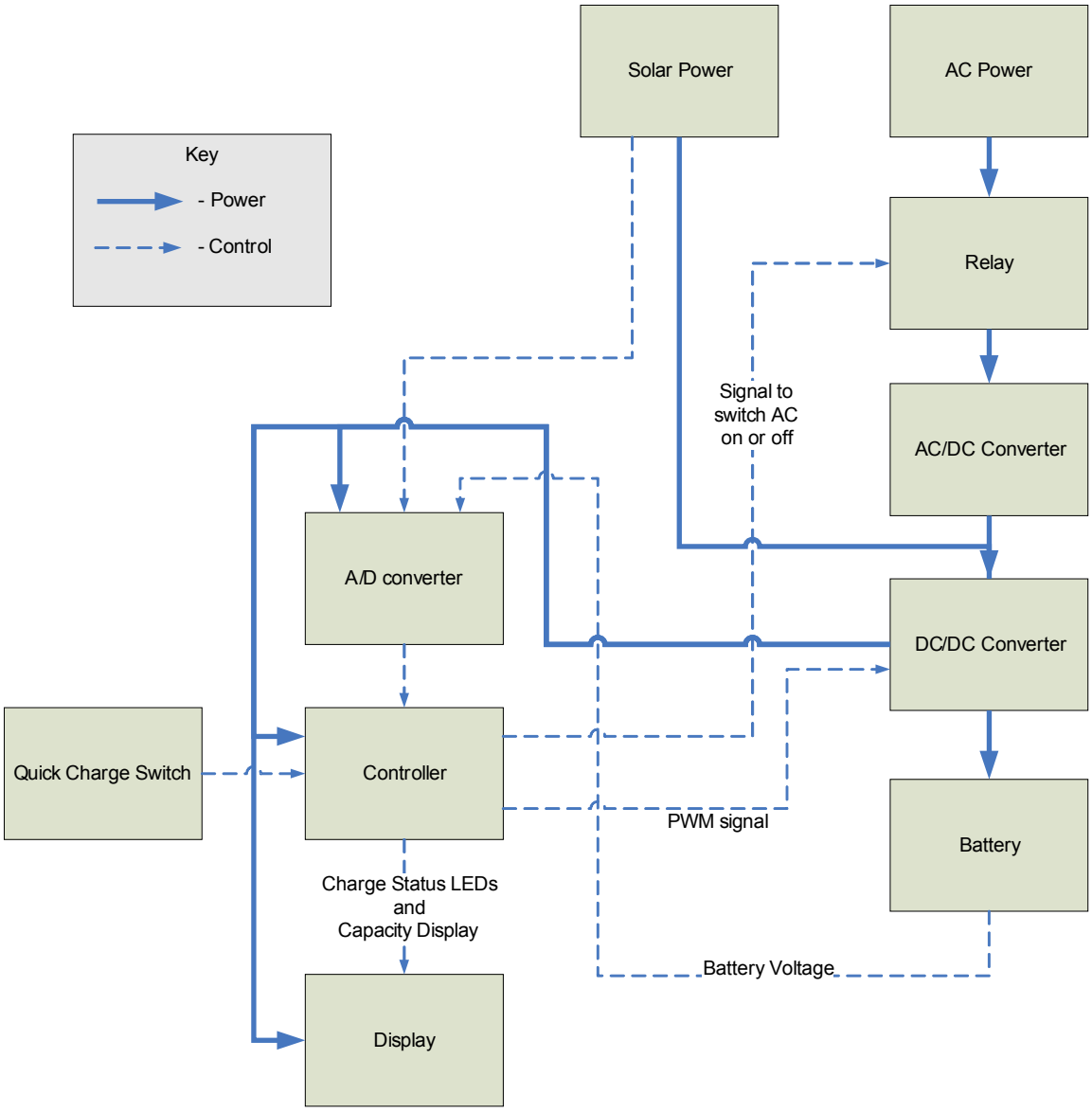


Fig. 3 – Battery Charger Block Diagram



Charger Subsystem Breakdown

AC Power: The AC power shall be standard 110VAC from a power outlet.

Relay: The relay shall have a control voltage that matches the output voltage of the controller (to be determined) and shall be able to switch 110VAC at a certain current (to be determined).

AC/DC Converter: Shall convert 110VAC to a DC voltage (to be determined).

DC/DC Converter: Shall regulate the DC power. Shall be able to power components as well as charge the battery.

Solar Power: Shall have a power rating that is sufficient to charge two discharged 12V batteries (wired in parallel) to full capacity over a period of five days.

Quick Charge Switch: Shall be a two position switch to switch charging mode.

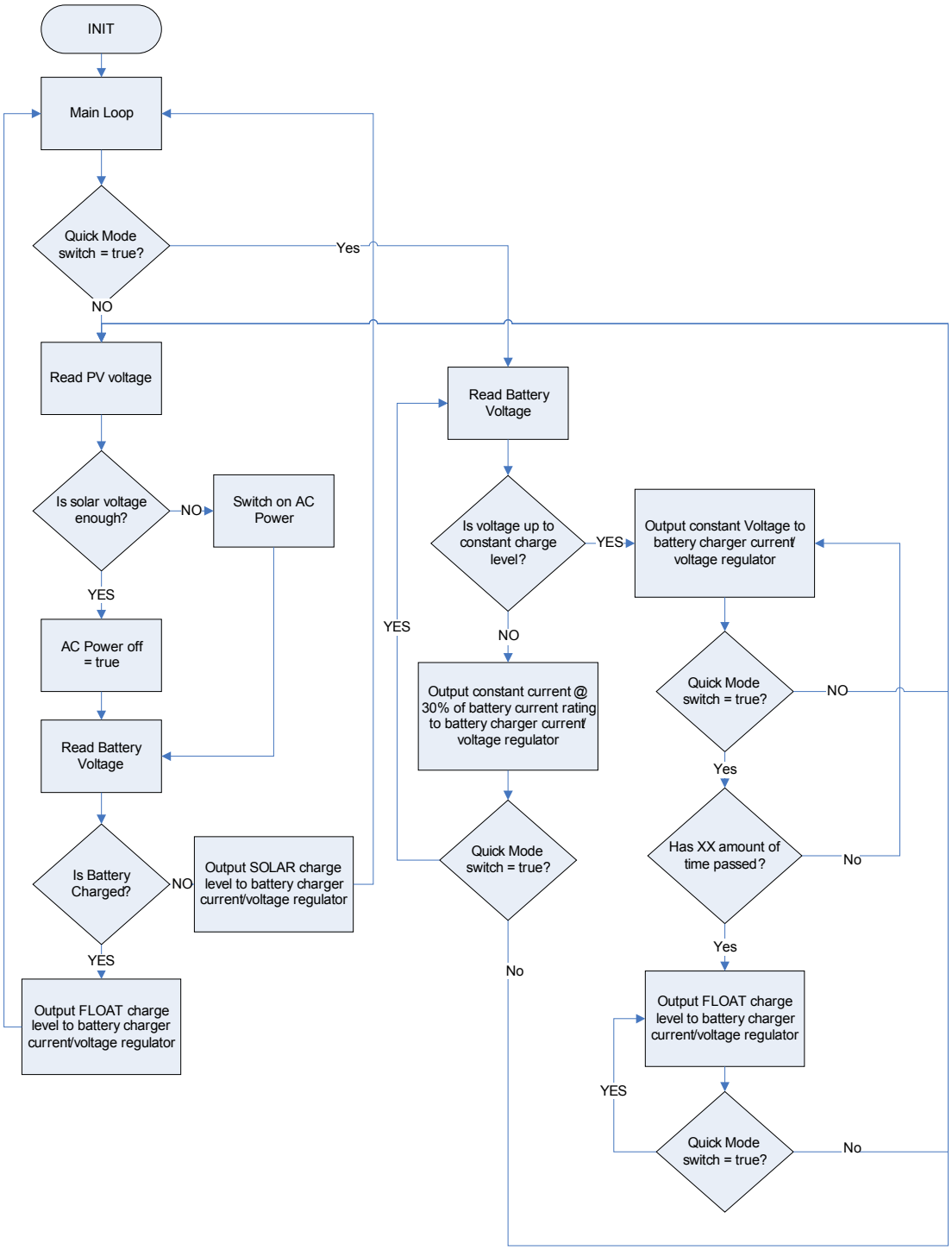
A/D Converter: The A/D converter shall have 8-bit resolution and have a range of at least 0-12 volts.

Charger Controller: The controller shall be used to control the charge algorithms for the batteries as well as calculate and display information about the state of charge of the batteries.

Display: The display shall be made up of at least two seven-segment displays and other LEDs that display the charge state of the batteries.

Battery: The battery block shall consist of two 12V batteries (as discussed in the lawnmower subsystem breakdown) that shall be wired in parallel for charging.

Fig. 4 – Flow Chart for Charger Controller



References

1. http://www.mindfully.org/Air/Lawn-Mower-Pollution.htm