1 Introduction

A controller for an electric bicycle must deliver power that varies from zero to the rated peak of the propulsion-motor, at motor speeds corresponding to bicycle speeds from zero to 48 km per hour (30 mph). With DC propulsion motors, power can be controlled with pulse-width modulated (PWM) transistors. AC motors need variable frequency. Hardware requirements for design of an electric-bicycle control are postulated and basic blocks along with their usage are shown.

An electric bicycle has a conventional bicycle frame, pedals, cranks, chain, and freewheel assembly. Electric propulsion replaces or supplements muscle power. This adds to the bicycle an electric motor, gear reducer, battery, and power control. The following defines the requirements of an electric bicycle:

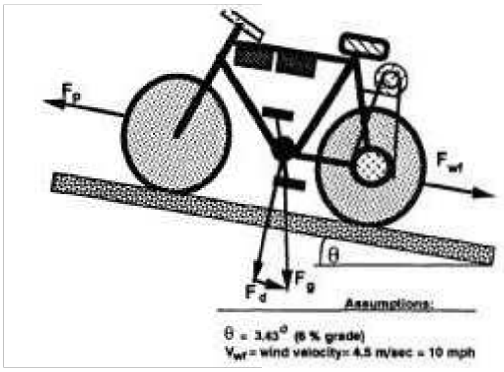
- The complete bicycle must have the lowest practical mass. All mass must be hauled over hills with energy supplied by the battery. Lower mass gives more range between recharging of the battery.
- Bicycle stability is another important requirement. Total mass need not affect stability, but the placement of mass is important.

Table 1 lists the range of mass that is considered to be propelled.

Table 1. Range of Mass

COMPONENT	MASS IN KG
Bicycle assembly	10
Motor and gear	6
Power control	1
Battery	6
Cyclist	80
Total weight	106

Figure 1 shows the required power to develop the necessary wheel torque for the indicated travel conditions:



F_{wf} = windage and friction drag F_d = downhill force from gravity F_P = propulsion force = F_{wf} + F_d

V_b = bicycle speed = 20 km/hr F_d = m sin x = 106 kg × 0.06 × 9.8 = 63 N

$P_d = F \times V_b$ = 63 × 5.56 m/s = 350 W Headwind speed = 25 km/hr, adds 30-W power to propel

Figure 1. Range of Mass

Hence the power required by the motor to propel the bicycle and rider is 380 W.