Problem Statement

Using a trusty, steady voltage source has become old fashioned when it comes to electronics. In some situations a running stream of water is more accessible than a 120V, 60Hz power outlet. If in this situation, it would be desirable to have an electrical generator that runs on the water flowing from a source such as a residential hose line and be able to cleanly generate enough power to run a governing electronic system and provide a steady power source. The governing system would need to be fully automated and able to run solely on the power generated from the stream of water.

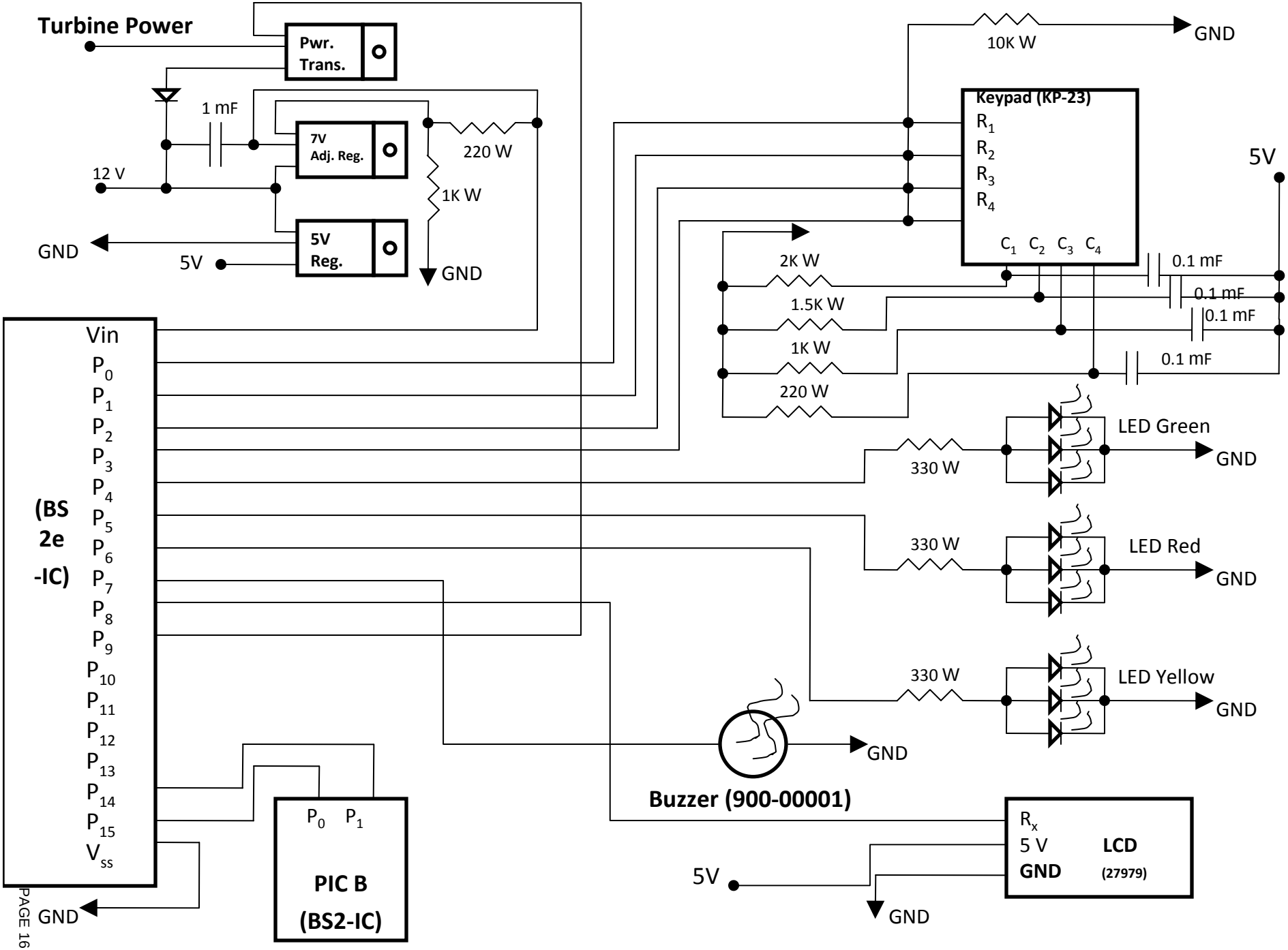
How it solves the Problem

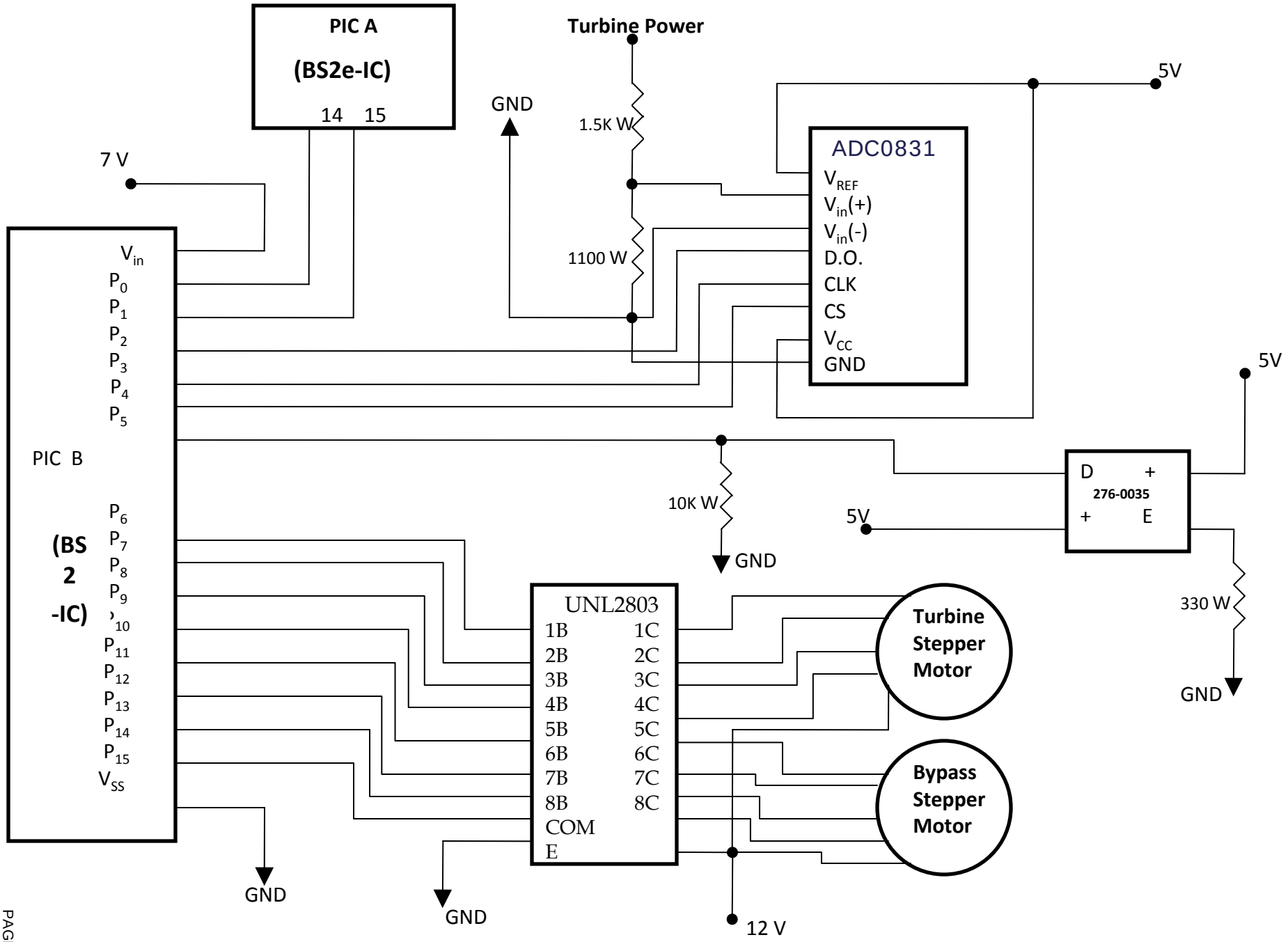
We took an unconventional approach to converting water flow to electricity. We decided to experiment with a device called the Tesla Turbine (description below). The Tesla Turbine allows for water to flow through it causing a shaft to rotate. The rotating shaft is connected to a motor which when run backwards can be considered a generator. The flow into and around the turbine will be controlled by flow restricting valves so that the user won't need to manually turn the valves. The valve positions, voltage being generated, and shaft rotational speed is communicated to the user via a LCD interface on the systems control panel. See below for a full description of the functions and capabilities of the device.

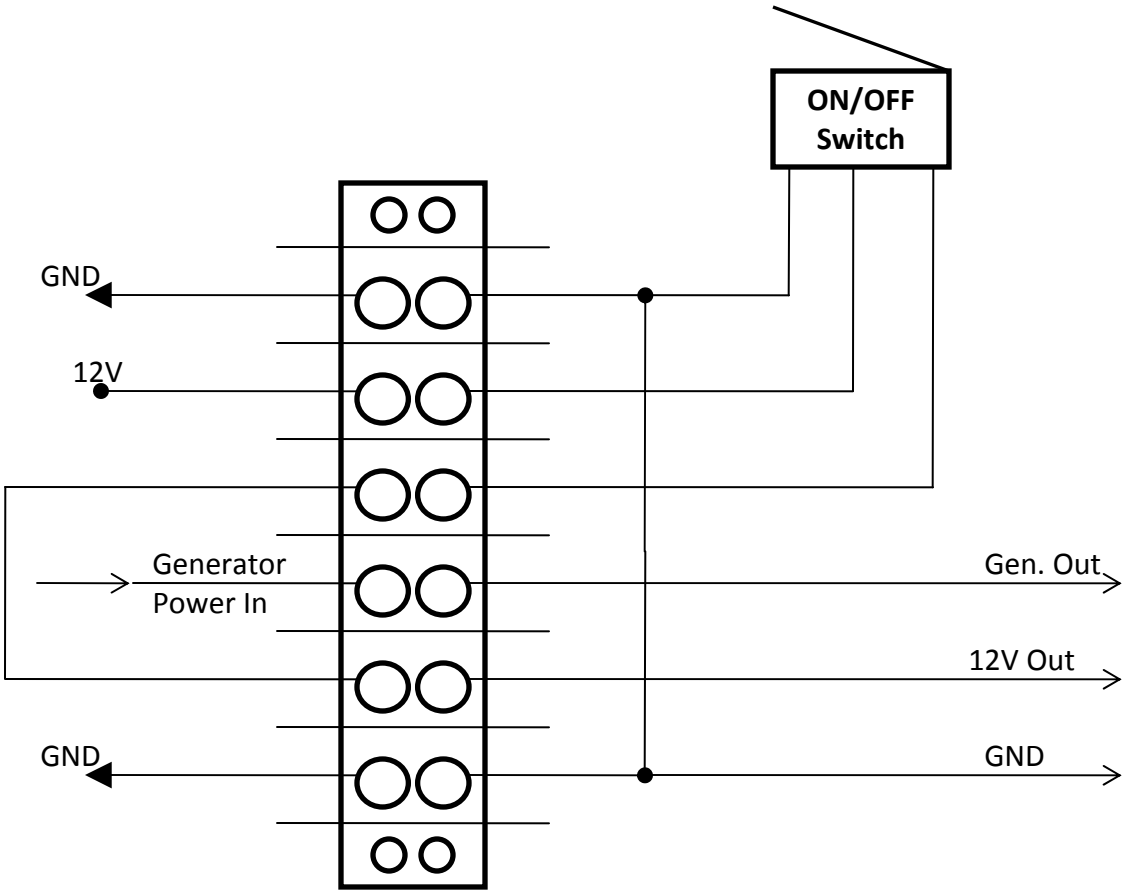
Design Summary

The Tesla Turbine was invented by Nikola Tesla in the early 1900's and was intended to be a generator for electricity. The turbine is dissimilar from the conventional turbine used to generate electricity because it doesn't use blades or buckets to convert high-pressure fluid into mechanical rotation of a shaft. Instead, the Tesla Turbine capitalizes on the drag generated on a surface due to a high velocity fluid flowing against it. The phenomenon that describes this interaction is called the *boundary layer effect* and is essential to operation of the Turbine. In our project, we have created a scale Tesla Turbine that converts water pressurized by a residential water system into electrical power. The power generated will then be used to completely run an automated governing system that is controlled by multiple sensors and microcontrollers that manage the following operations. Firstly, all selections and settings are user selectable by a 0-9 numbered keypad and communicated to the user through a 4X20 LCD display. Secondly, the flow into or around the turbine is user selectable based on two flow limiting vales. One valve will be simply an open or closed state (the bypass valve) but the valve controlling the flow through the turbine will have several user selectable positions that will base flow rate on a proportional valve position. Both valves will be managed by small 12Vdc Stepper motors which will be controlled by a microcontroller. A bank of three red, three yellow, and three green LED's will give the user a visual indication of how much voltage is being generated by lighting a proportional number of

these LED's. The LED's are proportioned as follows; Red for 0 to 2 volts, yellow for 3 to 4 volts, and green for 5 volts. The generated voltage and revolutions per minute of the shaft will be measure by appropriate sensors and displayed to the user when requested. The electricity comes from a human powered 12V bike light that has been connected to the rotating shaft of the turbine. Once enough power is being generated by the turbine to power the governing system, an alarm sounds, all LED's flash, and a message is displayed on the LCD alerting the user that the turbine can be switched off of the external power source and power itself using only the power generated by the turbine. At any time the user is able to shut down and then restart this sequence if desired by flipping the main power switch.


Turbine Power
Pwr. Trans.
1 mF
7V Adj. Reg.
220 W
12 V
1K W
GND
5V Reg.
5V
GND
10K W
GND
Keypad (KP-23)
R1
R2
R3
R4
C1 C2 C3 C4
5V
2K W
1.5K W
1K W
220 W
0.1 mF
0.1 mF
0.1 mF
0.1 mF
Vin
P0
P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
P13
P14
P15
Vss
(BS 2e -IC)
330 W
LED Green
GND
330 W
LED Red
GND
330 W
LED Yellow
GND
GND
Buzzer (900-00001)
P0 P1
PIC B (BS2-IC)
Rx
5 V
GND
LCD (27979)
5V
GND
GND


PIC A
(BS2e-IC)
14 15
Turbine Power
GND
1.5K W
1100 W
5V
ADC0831
V_{REF}
$V_{in}(+)$
$V_{in}(-)$
D.O.
CLK
CS
V_{CC}
GND
7 V
V_{in}
P_0
P_1
P_2
P_3
P_4
P_5
PIC B
(BS 2 -IC)
P_6
P_7
P_8
P_9
P_{10}
P_{11}
P_{12}
P_{13}
P_{14}
P_{15}
V_{SS}
10K W
GND
5V
D +
276-0035
+ E
5V
330 W
GND
UNL2803
1B 1C
2B 2C
3B 3C
4B 4C
5B 5C
6B 6C
7B 7C
8B 8C
COM
E
Turbine Stepper Motor
Bypass Stepper Motor
GND
GND
12 V


ON/OFF
Switch
GND
12V
Generator
Power In
Gen. Out
12V Out
GND
GND