TEI OF PATRA
INNOWEEK 2013

PV Powered Smart Irrigation

by Nick Panagopoulos
(student of Mechanical Engineering Dept.)

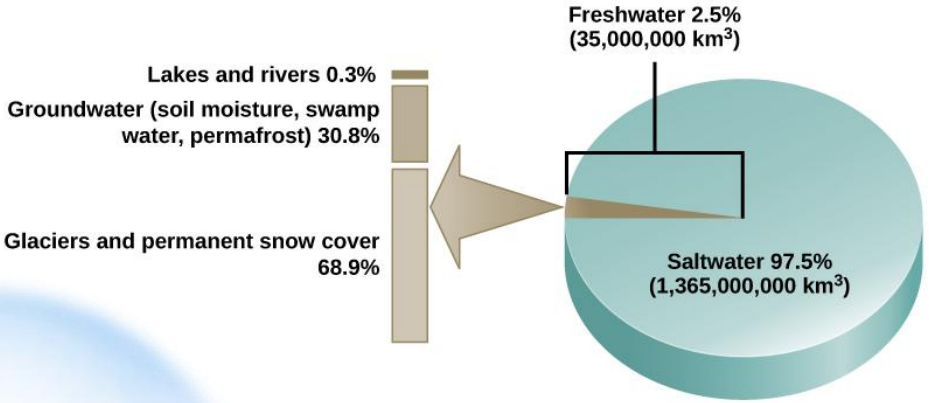
PATRA 2013

Introduction

Water

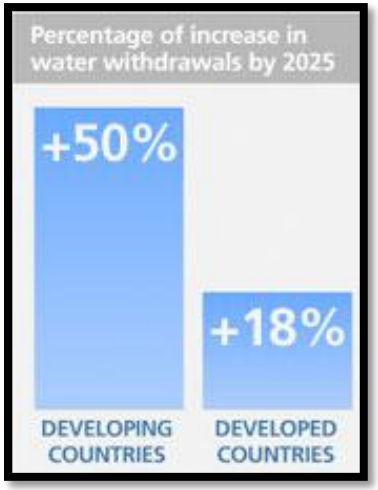
Water covers 71% of the Earth's surface, and is vital for all known forms of life. On Earth, 96.5% of the planet's water is found in oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps of Antarctica and Greenland and the rest in a gaseous state in the atmosphere (clouds and vapor).

- Only 2.5% of the Earth's water is freshwater, and 98.8% of that water is in ice and groundwater. Less than 0.3% of all freshwater is in rivers, lakes, and the atmosphere.



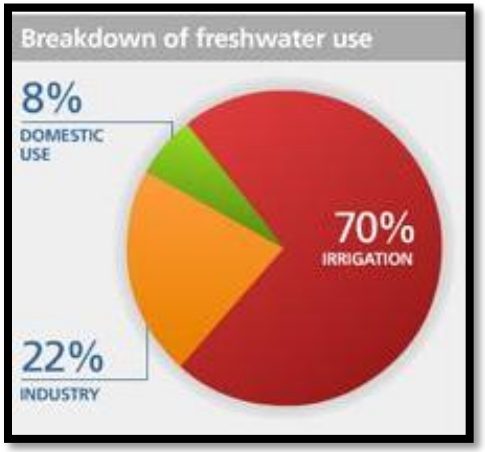
The world's population is growing by about 80 million people a year, implying increased freshwater demand of about 64 billion cubic metres a year. Competition for water exists at all levels and is forecast to increase with demands for water in almost all countries.

–UN Water Statistics, 2013



- Water is also required for the basic growth and maintenance of plants. More than 2/3 of the water consumed globally is used for irrigation.

–UN Water Statistics, 2013



Irrigation is the artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and revegetation of disturbed soils in dry areas and during periods of inadequate rainfall.

Irrigation Controlling

Automated irrigation control can be achieved by using two types of devices :

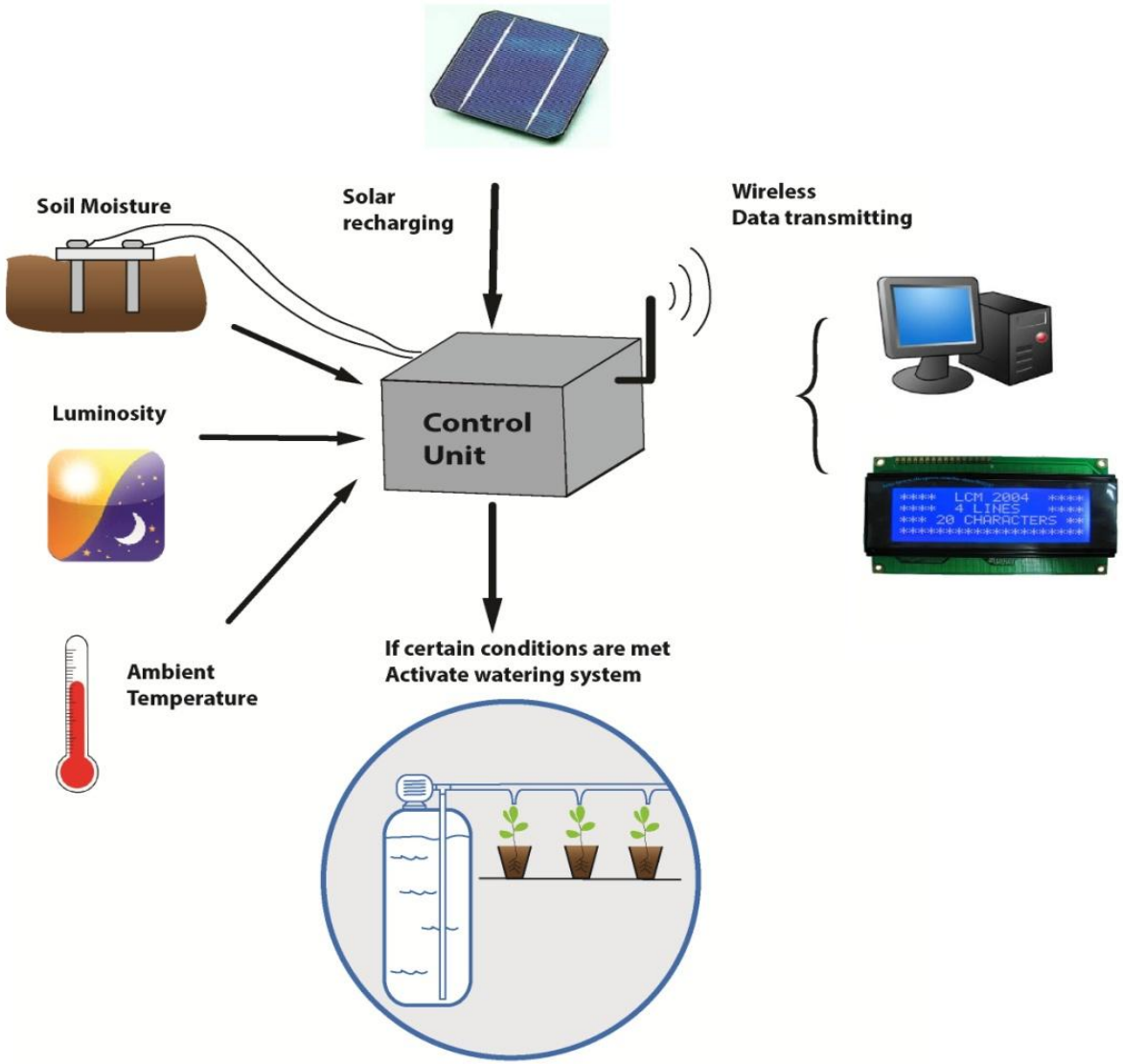
- Time based controllers
- Soil moisture sensing controllers

How Soil Moisture Sensor Systems Work

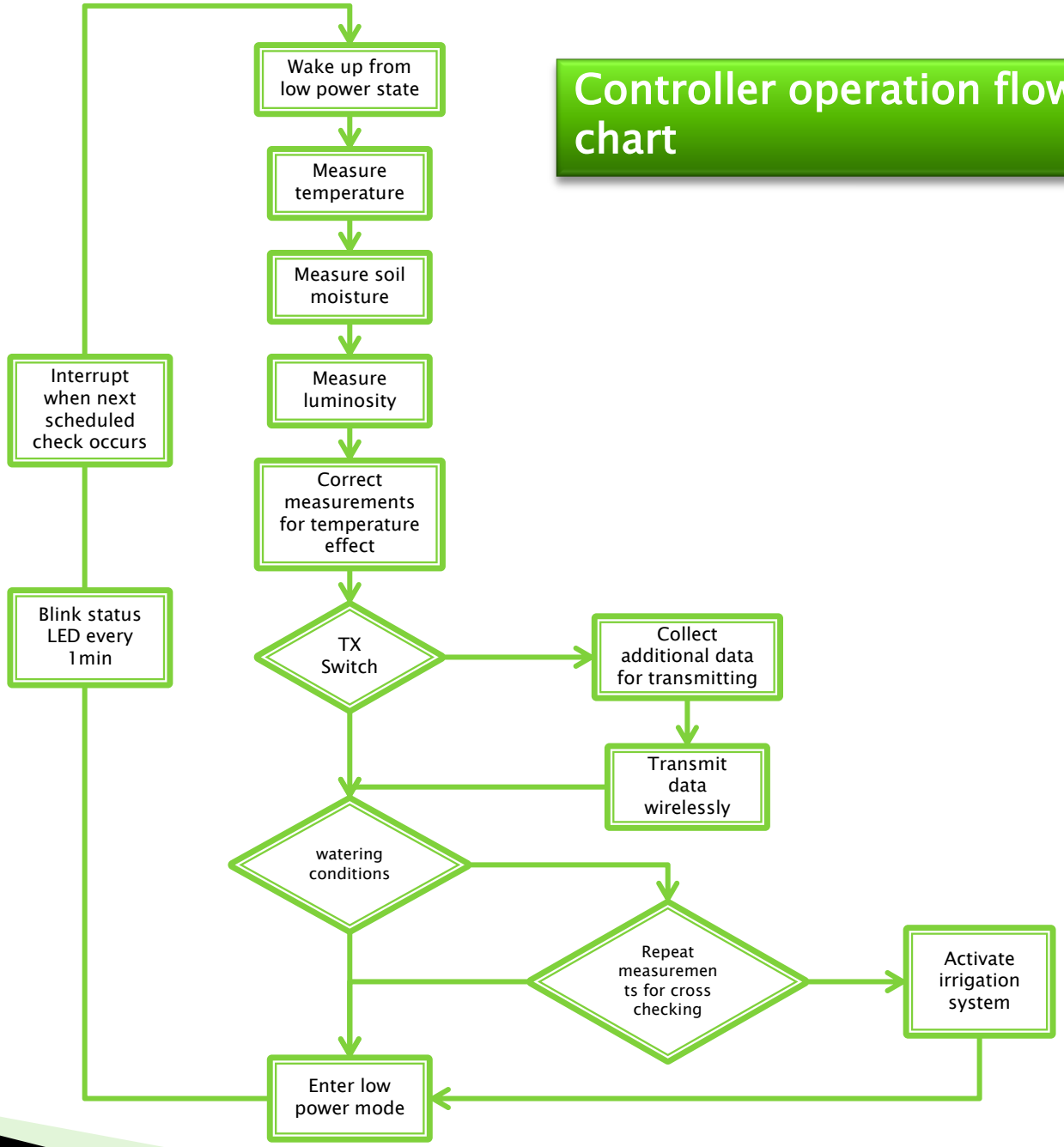
Most soil moisture sensors are designed to estimate soil volumetric water content based on the dielectric constant of the soil. The dielectric constant can be thought of as the soil's ability to transmit electricity and is increasing as the soil's content of water is increasing. This response is due to the fact that the dielectric constant of water is much larger than the other soil components, including air.

- Automated soil moisture sensor based irrigation systems have been shown to use 47% less water on average than systems that are not automated (i.e. hose and sprinkler), which can be attributed largely to the fact that set irrigation controllers (i.e. timed ones) do not readjust for varying weather conditions.

Operating principle



Controller operation flow chart

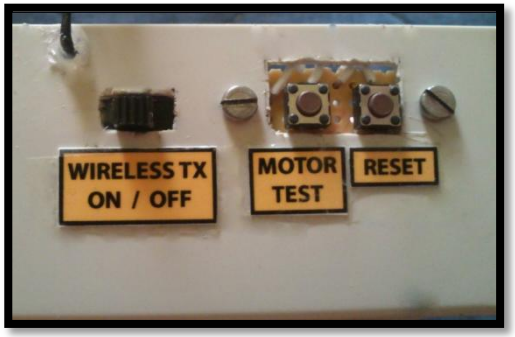


Controller Unit

- **Dimensions**
  100 x 100 x 55 mm
- **Battery**
  3.7V Li - Po - 400mah
- **Consumption**
  0.003W in idle mode
  0.06W in transmitting mode
- **Output connector**
  6A @ 4VDC cont.
- **Input**
  5V - 0.15A - 0.75Wp
  Polycrystalline Si

  or 7VDC from grid for recharging
- **Wireless transmitting range**
  100m unobstructed

Controller Unit (continued)

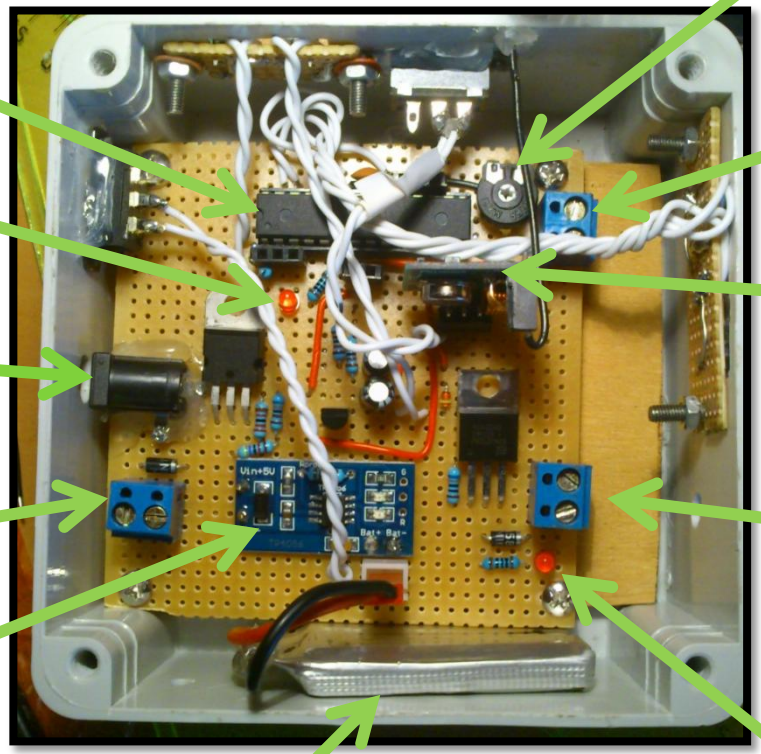


- Wireless Transmission ON / OFF switch
- Motor test button
- Reset button

- Power ON / OFF switch
- DC Plug

- LDR Luminosity Sensor
- LM35 Temperature Sensor

Controller Unit (continued)



MCU

Status LED

DC In 7V plug

PV Panel Connector

Charge controller

Li-Po battery 3.7V

Motor LED

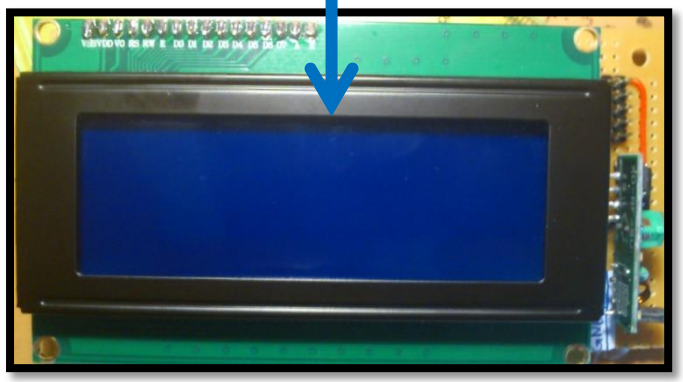
Power output 4V, 6A (max)

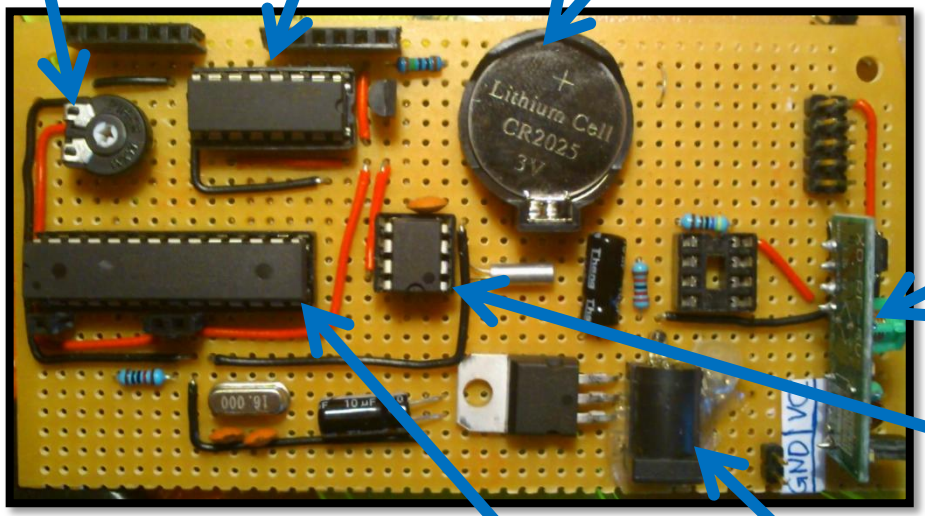
Transmitter Module 433MHz

Soil moisture sensor connector

Moisture threshold set

Receiver Unit





Dimensions

115 x 60 x 30 mm

Power Input

7 ~ 9 VDC

Consumption

0.6W

Receiver Unit (continued)

LCD Data displayed

- Date and time of last measurement
- Soil moisture in levels (0 ~ 1000)
- Temperature in Degrees Celcius
- Luminosity in levels (0 ~ 1000)

Main features

- **Soil moisture, luminosity and temperature monitoring**
  Monitoring of weather changes gives the ability of self adjusting according to the needs of the plants and also setting various profiles depending on the plant type.
- **Autonomous operation based on PV**
  Low power consumption gives the device the ability to recharge with only a few hours of sunlight and continue operation for many days without the need to recharge.
- **Lithium battery**
  The internal lithium battery can power a small DC motor able to supply 0.5 lt/min of water without any external components or turn on a more powerful AC motor with the help of a relay switch.
- **Wireless data transmitting**
  A LCD display or a computer can be used for data acquisition and overview or data logging of the measurements.
- **Internal voltmeters**
  Integrated voltmeters measure battery and input voltages providing a battery dry out protection and PV panel output monitoring capability.
- **Enviroment friendly**
  By supplying water to plants only when needed, the device makes good management of the available water resources and minimizes water wasting.

Application examples

Mini water pump

Small plant growing

Control Unit

Solenoid Valve

Garden irrigation

Relay

AC pump connected to power and water grid

Small field irrigation

Thoughts for future implementations

- Increasing the wireless range
- Creating a node of wireless sensors
- GSM and Internet data transmitting of status and alerts
- Wireless programming of the controller
- Up scaling of the controller to handle large field applications
- Add additional sensors (i.e PH meter)
- Include an automated fertilizing system

THANK YOU FOR YOUR ATTENTION