Efforts on Seedling Counting

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J.E. Love Seedling Lifter during Operation

Current Counting Methods

- Average tree density per length
- Weight

Seedling Counter for Lifting

- Principal of operation
  - Provide an accurate real-time count of seedlings lifted.
- Obstacles
  - Environment
  - Dependability
  - Reliable Results

Potential Solutions

- Photo-Interrupt Sensor
  - Laser transmitter and receiver paired to detect the presence of an opaque object
- Capacitive Sensor
  - Measures dielectric properties between two electrodes
- Microwave Sensor
  - Microwave transmitter and receiver paired to measure wave attenuation

Photo-Interrupt Sensor

- Advantages
  - Well researched
  - Hardware exists
  - Dependable results
  - Durable packaging
  - Easy to implement
- Disadvantages
  - False interrupts
  - Debris causing lens obstruction (dust,mud)

Capacitive Sensor

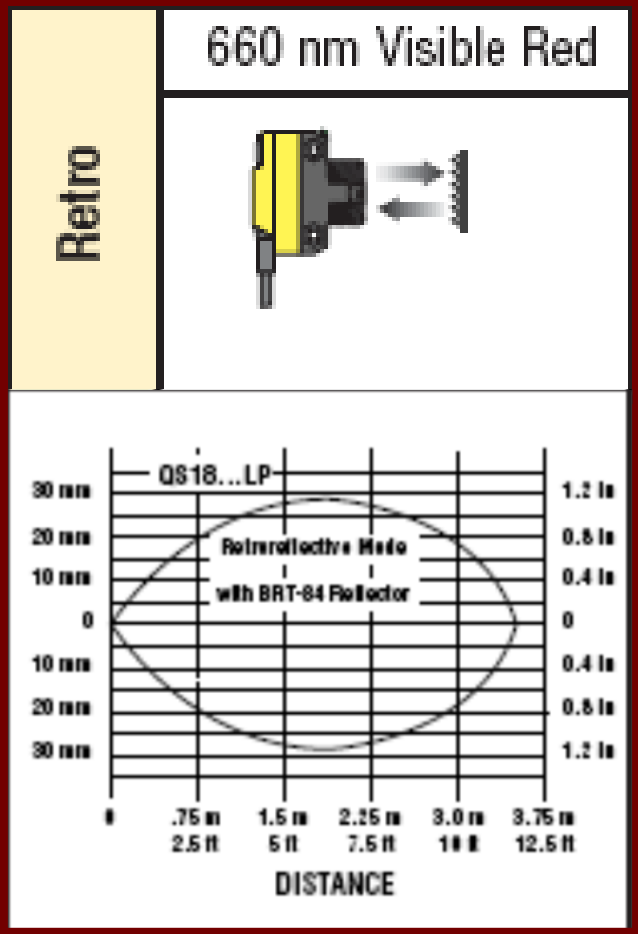
- Advantages
  - Durable sensor design
  - Dependable results
  - Not subject to small debris or dust
- Disadvantages
  - Difficult to implement
  - Hardware does not exist
  - Requires addition signal cables
  - Moisture dependant
  - Sensing electrode distance and size

Microwave Sensor

- Advantages
  - Durable sensor design
  - Not subject to the environment
- Disadvantages
  - Wave reflection due to close proximity of transmitter and receiver prevents this method from being a possible solution for this problem.

Photo-Interrupt Sensor

- Operation
  - Retro-reflective beam
  - Senses close objects



Capacitive Sensor

- Operation
  - Two electrodes create an electric field
  - The sensors' properties change when a dielectric enters the electric field
  - The changes can be detected and analyzed

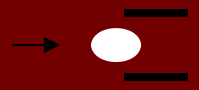
A seedling passes between two electrodes causing a detectable dielectric change.

A second seedling passes between the electrodes increasing the detectable dielectric change

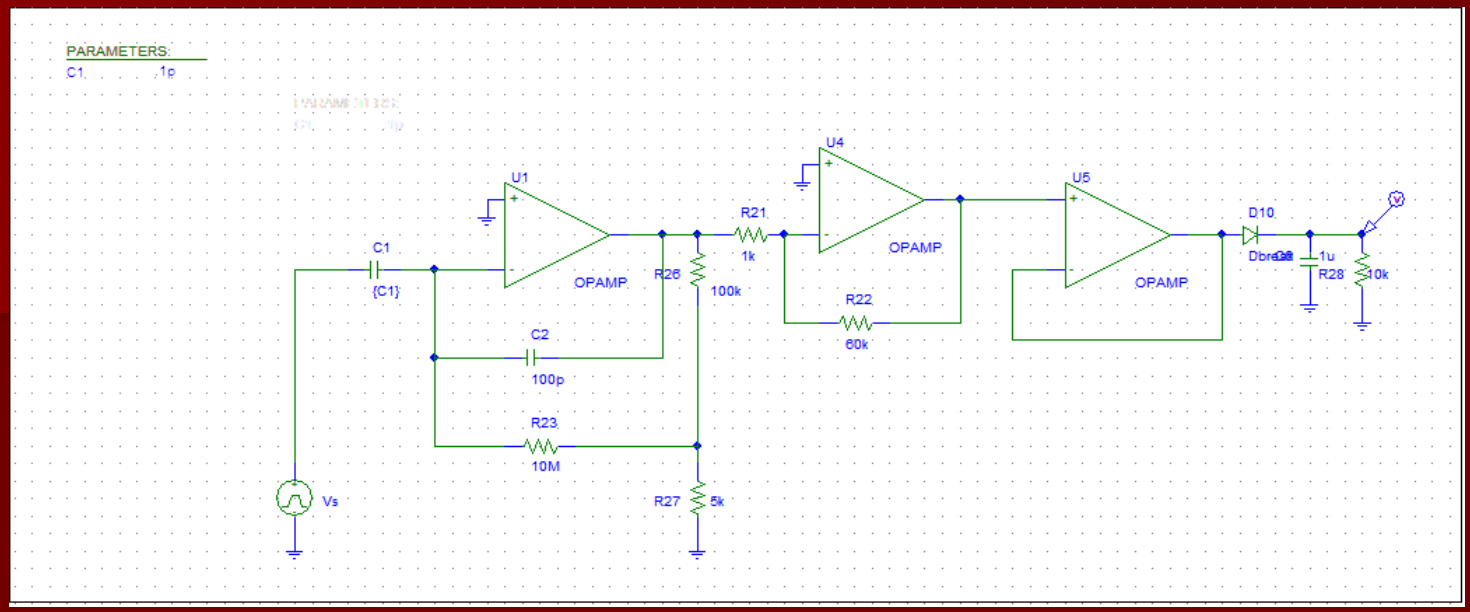
When a third seedling enters the sensing area as the first leaves, there is no sensed dielectric change

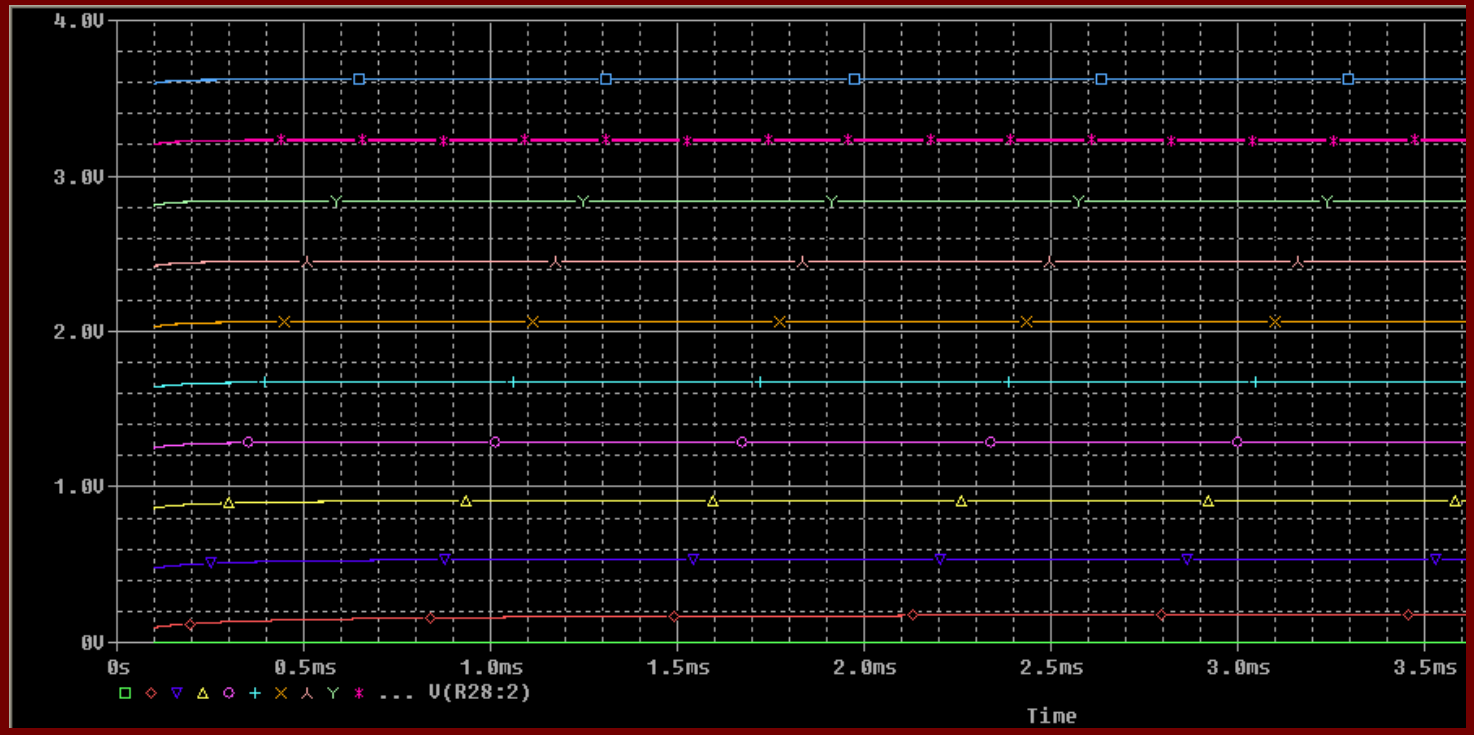
Capacitive Sensor

- Obstacles
  - Decrease the size of the electrode
  - Substantially decreases the value of the capacitor
  - Distinguishing the reduce capacitance change from signal noise



$$C = \frac{\varepsilon_o \varepsilon_r A}{d}; A = l \cdot w$$


PARAMETERS:
C1 1p
U1
U4
U5
OPAMP
OPAMP
OPAMP
C1
{C1}
C2
100p
R23
10M
R26
100k
R21
1k
R22
60k
R27
5k
Vs
D10
1u
R28
10k


4.0V
3.0V
2.0V
1.0V
0V
0s
0.5ms
1.0ms
1.5ms
2.0ms
2.5ms
3.0ms
3.5ms
... V(R28:2)
Time