Objective

General Need for Product
• Conventional lawn-care requires constant upkeep and can lead to over-watering
• Provide a method for automatically determining when soil needs to be watered

Physics of System

Market Size
• Approximately 3% of 965,000 households in the Washington area with lawn or garden
• $5 million in rubber hose and fittings purchases

Customer Requirements
• Weatherproof
• Hose Compatibility
• Large Water Savings
• Durable Case
• Set Moisture Levels
• Ease of Installation
• Easily Concealable
• Timer Override

Engineering Characteristics
• Water Intrusion
• Footprint and Height
• Number of Buttons and Inputs to Operate
• Moisture Sensor Sensitivity
• Number of Watering Zones
• Water Leakage
• Installation Complexity

Constraints
• AC Power
• Weight
• Varying Water Pressure
• Timer Function

Concept Generation

Concept 1: All in One
• Pro: Simplicity of having entire unit in one self-contained box.
• Pro: Lack of overlapping parts
• Con: Large overall footprint and weight

Concept 2: Four Way Valve
• Pro: Steady seal at the pressurized inflow
• Pro: Smaller footprint and weight
• Con: Failure at four way valve would compromise the entire system

Concept 3: Independent Controls
• Pro: Customer can purchase as many or as few units as they need
• Pro: Failure at one segment will not affect remainder of the system
• Con: Independent control boxes will increase footprint

Prototype and Testing

Key Innovation
• Real time soil moisture readings that allow for varying weather and sun coverage
• “Set and Forget” system requires no upkeep

Estimated Price: $99

Moisture Calibration Testing
• Calibration performed to ensure accurate sensor reading
• Data recorded when submerged in water
• Data recorded for dry soil
• Soil micro-waved to ensure dryness

Moisture Behavior/Range Testing
• Moisture sensor behavior based on amount of water added
• Zone range based on 1 gal/hour flow rate out of a single dripper
• Water diffusion rate through soil
• Field Capacity

Test Results and Future Work

Future Work
• Configure circuitry on a PCB
• Acquire feedback from actual homeowners
• Perform lifecycle tests

Summary and Reflection
• Satisfied the customer need to automatically provide water only when soil is dry
• Device is able to water separate zones
• Patent analysis helped the team brainstorm concepts ideas
• Testing of prototype sensors was important in establishing when soil needs to be watered and the size of the watering zones

Customer Requirements
• Timer Override
• Easily Concealable
• AC Power
• Footprint
• Weight
• Number of Watering Zones
• Price
• Number of Inputs to Operate
• Convenient
• Water Leakage
• Sensitivity of Moisture Sensor
• Installation Complexity

Decision Characteristics

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All in One design rated highest

Concept 1
• All in One Design

Concept 2
• Four Way Valve

Concept 3
• Independent Controls

Design

Operation of Product
• Soil sensors read moisture levels in three separate zones and alerts a controller when any zone drops below a preset level
• Controller turns on valve controlling water flow in drip line to alerting sensor
• Once soil moisture is back above threshold, controller shuts drip line valve

Tradeoffs
• Soil moisture sensors must be placed along drip lines
• System assumes all conditions in each zone are identical

View of system in casing

Concepts

INDEPENDENT CONTROL DESIGN SCORE: 1.55
FOUR WAY VALVE DESIGN SCORE: 3.25
ALL IN ONE DESIGN SCORE: 4.29

Mechanical Engineering Design Day
May 7, 2013