Automate Reading Water Level In Tank

Goal - Automatically read tank levels and notify
water manager and board members via text, email or phone

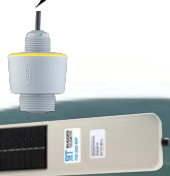

Radar Sensor

Battery with Transmitter

Read TANK LEVEL with Sensor & Satellite

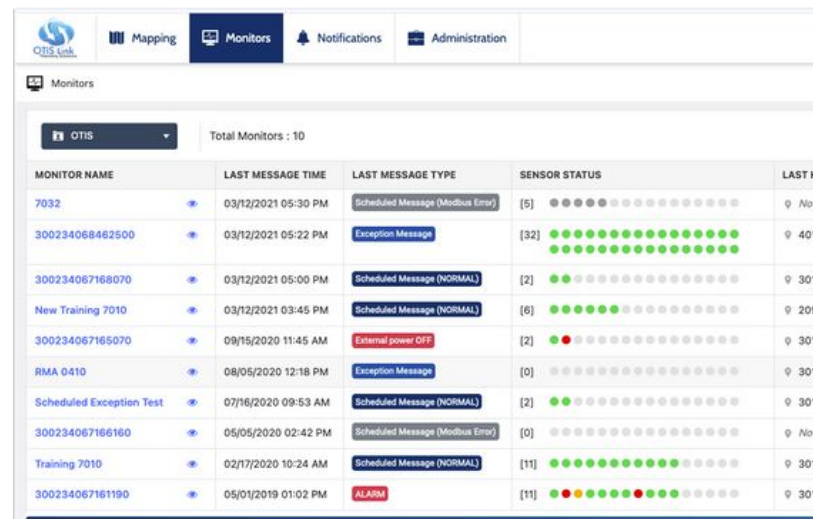**Satellite Network**
24/7 Global Coverage

Website - stores readings
and sends levels to specific users

Radar Sensor
reads tank level

Solar Powered Transmitter
sends level to Server via satellite

Read the Tank Levels
10 times per day.

		MONITOR NAME		LAST MESSAGE TIME	LAST MESSAGE TYPE	SENSOR STATUS		LAST KN
OTIS		Total Monitors : 10						
		7032	👁	03/12/2021 05:30 PM	Scheduled Message (Modbus Error)	[5] ●●●●●○○○○○○○○○○○○○○○○○		📍 No L
		300234068462500	👁	03/12/2021 05:22 PM	Exception Message	[32] ●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●		📍 401 S
		300234067168070	👁	03/12/2021 05:00 PM	Scheduled Message (NORMAL)	[2] ●●○○○○○○○○○○○○○○○○○○○○		📍 301 S
		New Training 7010	👁	03/12/2021 03:45 PM	Scheduled Message (NORMAL)	[6] ●●●●●●○○○○○○○○○○○○○○○○		📍 209 S
		300234067165070	👁	09/15/2020 11:45 AM	External power OFF	[2] ●○○○○○○○○○○○○○○○○○○○○○		📍 301 S
		RMA 0410	👁	08/05/2020 12:18 PM	Exception Message	[0] ○○○○○○○○○○○○○○○○○○○○○○		📍 301 S
		Scheduled Exception Test	👁	07/16/2020 09:53 AM	Scheduled Message (NORMAL)	[2] ●●○○○○○○○○○○○○○○○○○○○○		📍 301 S
		300234067166160	👁	05/05/2020 02:42 PM	Scheduled Message (Modbus Error)	[0] ○○○○○○○○○○○○○○○○○○○○○○		📍 No L
		Training 7010	👁	02/17/2020 10:24 AM	Scheduled Message (NORMAL)	[11] ●●●●●●●●●●●○○○○○○○○○○○		📍 301 T
		300234067161190	👁	05/01/2019 01:02 PM	ALARM	[11] ●●●●●●●●●●●○○○○○○○○○○○		📍 301 T

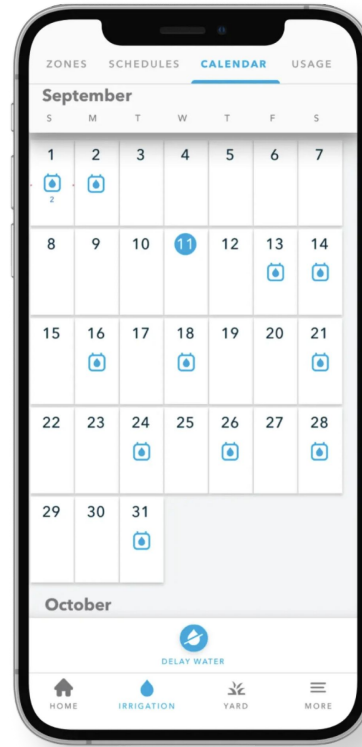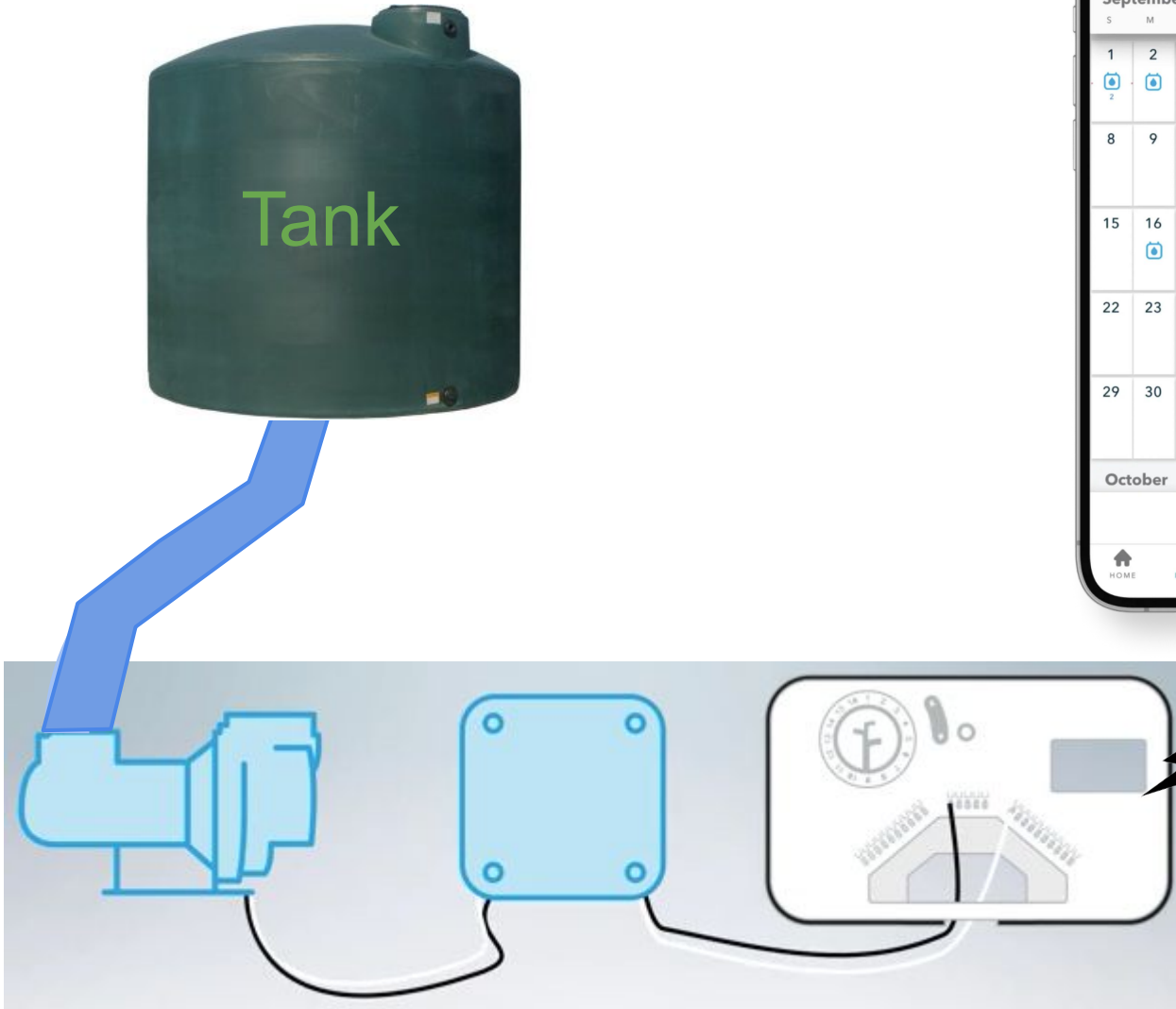Mapping · Monitors · Notifications · Administration

Monitors

Receive tank level readings from
website, email, phone or text

No more driving up the Canyon for 60 miles
every month taking 8 hours...

Adjust PUMP Schedule with WIFI

Tank

Adjust the Pump
Schedule from
Anywhere & Any Time

Community Center WIFI

Peterson Pump   **Relay**   **WIFI Controller**

Controller	$149
Relay	$99
Enclosure	$40
App	Free

Pump Relay Details   Relay   Controller

Automatic Reading Water Level in Tank

Background

In order to manage the water system, the water level in the tanks have to be known and maintained at certain levels. Currently this task is performed by physically driving up the canyon and inspecting the levels at least once per day. This takes time, money and requires someone *onsite*. This research proposes a way to automatically measure the level of the tank and send that information to people via email, text or phone call as well as storing the history online.

Automation Benefits

- **Perform Task Anywhere** - allows this vital task to be manned from anywhere in the world from the internet.
- **Save Money** - About 70 miles per month of gas and vehicle wear (2 mile round trip from Canebrake/Canyon)
- **Save Time** - 100+ hours of driving per year
- **Less neighborhood interference** - less driving up the canyon or foot traffic on Whitley property
- **Leak Detection** - monitor for leaks during the night when consistent water seepage changes happen
- **Water Level Warnings** - software allows alerts to be sent if levels are too low or high
- **Needed for Full Automation** - knowing the tank levels is needed to remotely adjust the pump schedule in the future

How it Works

There are Five parts to the System

- **Sensor** - reads the water tank level very accurately without touching the water using a Radar sensor mounted on top of the tank. Installs easily using NPT thread.
- **Battery** - uses an industrial solar charged sealed battery for the sensor and transmitter.
- **Transmitter** - sends sensor signal to a global satellite network running 24/7.
- **Communication Subscription** - monthly charge to send sensor data 10 times per day.
- **Web Data Center** - website that stores the data and allows for viewing the data. Sensor data can also be sent to email, text message or phone call to subscribed users. Alert notifications can be created for certain levels of data.

More Info

We would only need one sensor for the Big Tank. We are using that tank most of the time. If we want to use two locations with different elevations (eg Poly Tank location or Steel tank), then we would need two sensors. This system works even when there is no power at Canebrake! Creates an IoT (Internet of Things) technology to modernize our water system.

Currently at the tank locations we have limited WIFI, cellular coverage and power. This solution bypasses those limitations. Radio frequency may work since it's a short distance to Peterson and RF site survey is needed. **Considerations include**: cost, reliability of readings, integration with our system, withstanding our harsh environment and customization needs.

Measure Tank Level - Satellite Solution

1. Mount Radar Sensor
on top of the tank

- **Accurate** - measuring range up to 8 meters with accuracy **±5 mm** *(45 gallons resolution steel tank, 13 gallons resolution poly tank)*
- **Reliable** - maintenance-free operation due to non-contact 80 GHz radar technology
- **Easy Installation** - with 1 ½ inch NPT fitting

2. Connect Satellite Telemetry
(includes battery and solar recharger). Sits on top of Tank.

- Weight: ~1 lb
- Size: 12" x 3" x 2"
- Battery life 7-10 years
- Replacement unit (case, solar, battery) $300
- Temperature: -4 to 140 F
- The TiQ.200 series is the most advanced single tank monitoring product on the market

3. Configure System
Use Data Center website to configure personal to receive readings and notification method.

- Read Tank Levels
- Store and Read historical readings
- Receive readings 3 to 10 times per day
- Configure recipients for notifications
- Set notification method (SMS, Email, Phone)
- Create alerting rules: how often to check alerts and how often to send message. Default: check every 15 min, send every 6 hours. Alert is Sent when they happen (eg low tank level)

Telemetry Suggestions

TIQ 200 series - suggested by Rugged Telemetry engineer
TiQ.215 series - works with any analog sensor from any vendor

https://www.ruggedtelemetry.com/products/tank-monitoring-single-tank

Sensor Suggestions

Vega Pulse C11 Radar Sensor
Pulsar Reflect Radar Sensor

COST

Telematics Control Unit	$625
Radar Sensor (Pulsar)	$795
Sensor Junction Box	$150
Mounting bracket	$40

Total Hardware	**$1610**

Total Hardware ~$1610 (includes taxes)
Satellite Monthly Fee - $30
Two Sensors Monthly Fee - $45

Daily Cost Over 8 Years
$1.54 per day for 1 sensor
(1610+(8yrs*12month*$30))/(365 * 8yrs)

Polyethylene Tank
10k gallons
13 feet height, 12 feet wide

Radio Frequency Solution

Control the pumps automatically using Radio Transmitters and Programmable Controllers.

At the Tank
- **Pressure Sensor** - connected at outflow of tank to measure volume of tank based on pressure eg 7 PSI sensor
- **PLC** - Programmable Logic Control to take value from pressure sensor and give to RF Transmitter
- **Radio Frequency Transmitter** - sends signal to the PUMP
- **Radio Antenna** - to send signal to pump
- **Two Batteries** - 12 volt batteries in the shade to power the PLC
- **Solar panels** - to recharge the batteries

At the Pump
- **Radio Antenna** - to receive signal from tank
- **Radio Frequency Receiver** - receive signal from the TANK
- **PLC** - Programmable Logic Control to take value from RF Receive and turn on/off pump
- **Electronics** - conduit, relay, etc

Site Visit to Borrego Water District March 8
Control Systems Engineering design & installed their system (6 tanks, 10 wells, 2 sewage)

Phone call with https://controlsystemseng.com/ Eric Bloom
- Site Visit **$2500** - provide RF test, design with specs and hardware and install bid
- Install Cost **$13k** - High Estimate for 1 tank & 1 pump (parts and labor)

PLC Programming Ref2   PLC Programming

References & POC's

Satellite Telemetry Solution - to send sensor data via satellite
https://www.ruggedtelemetry.com/products/tank-monitoring-single-tank

Pulsar Radar Sensor - a specific radar sensor
https://pulsarmeasurement.com/en/reflect
Radar Sensor Manual
https://pulsarmeasurement.com/downloads/download/reflect-manual-first-edition-rev-3.pdf
Another Radar Sensor
https://www.vega.com/en-us/products/product-catalog/level/radar/vegapuls-c-11

RF Telemetry Solution - to send sensor data via Radio Frequency to Receiver
https://nikeson.com/en-us/collections/sentinel-wireless-level-monitoring
RF Manual
https://cdn.shopify.com/s/files/1/2506/5582/files/Sentinel_Smart_Level_Monitoring_System-_Data_sheet_01.pdf?v=1611323637

Sensor Types - to measure water tank levels
https://blog.wellaware.us/blog/what-is-the-best-tank-level-sensor-accurate-reliable-tank-level-monitoring

Steps to Monitor Water Level (blog)
https://blog.wellaware.us/blog/how-to-monitor-water-level-in-a-tank-complete-guide

Automate Turning on Pumps - domestic company to turn pumps on and off
https://wellaware.us/water-and-wastewater/

Manual Tank Level Equipment
https://rainwaterequipment.com/liquidator-2-water-tank-level-gauge/

Lower Power Rate Schedule
https://www.sdge.com/residential/pricing-plans/about-our-pricing-plans/whenmatters

Telemetry Company
Rugged Technology Inc.
Jason Carabetta
428 Roy Arnold Ave.
Danville, KY 40422

Mobile: +1 (201) 707-2020
Office: +1 (973) 446-0799
Email: jason@ruggedtelemetry.com

PLC Class

WIFI Automation

Alternate

Remote Pump Activation Company
Wellaware
John Morgan
johnmorgan@wellaware.com

TOU Period	Summer June 1 - October 31	Winter November 1 - May 31
On-Peak	4 p.m. - 9 p.m. Weekdays	4 p.m. - 9 p.m. Weekdays
Off-Peak	All Other Hours Plus Weekends and Holidays	All Other Hours Plus Weekends and Holidays

Shows On & Off Peak Hours

Electric Bill