TOUCH IOT WITH SAP LEONARDO PROTOTYPE CHALLENGE

SMART SHIPPING CONTAINER AQUAPONICS
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**Background**

Due to growing water shortages and global climate change, Intergovernmental Panel on Climate Change (IPCC) predicted that global food production could decline by 2% per decade, at a time in which food demand could increase 14% per decade [1]. To produce more food under increasingly difficult environment, many commercial farms are utilizing aquaponics systems to produce vegetables and fish, often in an indoor environment. Basically, an aquaponics system combines aquaculture (fish farming) and hydroponics (grow vegetables without soil) to produce fish and vegetables together in an integrated system [2]. One big advantage is that aquaponics uses 90% less water than traditional farming [3], plus placing aquaponics systems indoor shield crops and fish from potentially volatile weather due to climate change.

**Summary**

A manager of a large urban farm manages 15 “Shipping Container” aquaponics units. To ensure optimum food production, the manager needs to monitor each unit in real-time every day.

**Storyline**

Inside an industrial park area of a large city sits a 5-acres urban farm. At the farm, in addition to 2 greenhouse nurseries, there are 15 “Shipping Container” aquaponics units. In each unit, the aquaculture level (1st level) contains a large fish tank raising Tilapia fish, and the hydroponics level (2nd level) is a small rooftop greenhouse containing hydroponic farm to grow variety of vegetables/herbs. To relocate to a new location, each unit can be towed by a truck.

For the farm manager to optimize food production in a given “Shipping Container” aquaponics unit, she on a daily basis must be able to monitor it on various measurements in real-time. She must be able to get notified of problems immediately via alerts on a mobile device. For the hydroponics level, she must be able to monitor average air temperature and air humidity. Also at the aquaculture level, she must be able to monitor the average water temperature, acidity, oxygen level, turbidity, and water pump flow. In addition, she must be able to monitor the unit’s overall energy consumption, for support systems including water pumps requires electricity.

**Source**

Persona

Jennifer
Urban farm manager

“I like to be able to monitor all the aquaponics units at my farm in real-time, every workday.”

About

- 27, single, 5 years of urban farm management experience.
- Being the person in charge of the farm and the 15 “shipping container” aquaponics units, I must monitor each unit on a regular basis. Doing so allows me to take immediate actions if I do spot problems, so to ensure undisrupted food production while maximizing profits for the farm.
- Very mobile, moving from place to place during the day.
- I work with Chief Facility Engineer, Technicians, Farm Workers, and Office Assistants. I report to my boss who owns the farm.

Responsibilities

- I am responsible for day-to-day farm operation.
- I spend more than 35% of my time in the office inside the farm, delegating works to employees to ensure the farm is profitable in the long run.
- I am responsible for monitoring the conditions of the 15 “shipping container” aquaponics units, as well as 2 greenhouse nurseries.
- If any of the 15 aquaponics system units got problems, I must make timely adjustments (e.g. add lime to increase water PH level) or send Technicians to fix any unit breakdowns.

Main Goals

- Being the person managing the urban farm’s 15 “shipping container” aquaponics units, I must monitor each unit in real-time, to spot problems and breakdowns so I can make timely adjustments or notify Technicians to fix breakdowns ASAP.
- Greatly reduce time I need to monitor all aquaponics units, so to free-up time for me to engage in other profitable activities like marketing.

Needs

- Need to be able to monitor aquaponics units in real-time, so to immediately spot and fix problems.
- Make aquaponics unit monitoring efficient to free up time for more important farm activities.
- Efficiently collect data and perform analysis on the aquaponics units to streamline operations.

Pain Points

- Can’t monitor aquaponics units in real-time.
- Time consuming to personally check everything in each aquaponics unit to spot problems.
- Can’t pinpoint problems immediately to make timely adjustments or fixing unit breakdowns.
- Lacks effective data collection and analysis tools.
Point of View

As an urban farm manager managing aquaponics unit operations

I need a way to effectively and efficiently monitor all the aquaponics units in real-time

so that I can quickly spot problems in aquaponics units to make timely adjustments or get technicians to fix breakdowns ASAP without the need for too much guesswork.
### ACTIONS

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<tr>
<td><strong>USUAL DAY AT THE FARM</strong></td>
<td><strong>CHECK ON AN AQUAPONICS UNIT</strong></td>
<td><strong>SEE THE PH LEVEL IS TOO LOW, WITH LOW OXYGEN LEVEL IN THE WATER!</strong></td>
<td><strong>TECHNICIAN CAME TO CHECK THE UNIT'S AQUACULTURE LEVEL.</strong></td>
<td><strong>WAITING FOR TECHNICIAN TO FIX THE UNIT’S WATER PUMP.</strong></td>
<td><strong>PUMP FIXED AFTER 2 HOURS, AQUACULTURE IN THE UNIT RESUME OPERATION.</strong></td>
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<tr>
<td><strong>SEEING MANY DEAD TILAPIA FISH FLOATING ON THE WATER.</strong></td>
<td><strong>CHECK ON WATER TEMPERATURE, PH LEVEL, TURBIDITY, OXYGEN LEVEL, AND WATER PUMP FLOW IN THE FISH TANK.</strong></td>
<td><strong>ADD LIME TO INCREASE PH LEVEL, CALL TECHNICIAN TO INVESTIGATE OXYGEN ISSUE.</strong></td>
<td><strong>EXPLORED THE UNIT, SEE WATER PUMP IS NOT WORKING PROPERLY.</strong></td>
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### MINDSET

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<tr>
<td><strong>“OH NO, SOMETHING IS HORRIBLY WRONG WITH THE FISH TANK!”</strong></td>
<td><strong>“LET ME CHECK THESE MEASUREMENTS ON THE MONITORING UNIT: WATER TEMPERATURE, PH LEVEL, TURBIDITY, OXYGEN LEVEL, AND WATER PUMP FLOW.”</strong></td>
<td><strong>“WATER IS WAY TOO ACIDIC, PLUS OXYGEN LEVEL IS LOW!”</strong></td>
<td><strong>“SO BAD WATER PUMP CAUSES THE TANK TO STAGNATE, INCREASING PH LEVEL AND DEPLETING OXYGEN FOR THE FISH.”</strong></td>
<td><strong>“IF I CAN DETECT PH LEVEL AND OXYGEN ISSUES EARLIER FOR THIS UNIT, I CAN SAVE LOTS OF FISHES, AND SAVE MYSELF LOTS OF FRUSTRATIONS!”</strong></td>
<td><strong>“BOSS SAID THANKS FOR FIXING THE ISSUE. BUT WE ARE STILL UNSATISFIED.”</strong></td>
<td><strong>“IS THERE A WAY FOR ME TO MONITOR AQUAPONICS UNITS IN REAL-TIME, AND GET NOTIFIED OF THE PROBLEMS IMMEDIATELY TO FIX PROBLEMS EARLIER?”</strong></td>
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<tr>
<td><strong>“REMOVE DEAD FISHES BEFORE DECOMPOSING!”</strong></td>
<td><strong>“LET ME CALL PHIL THE TECHNICIAN, TO DISCOVER WHY OXYGEN LEVEL IS LOW.”</strong></td>
<td><strong>“LET ME ADD LIME TO INCREASE WATER PH LEVEL.”</strong></td>
<td><strong>“PHIL SAID NEED 2 HOURS TO FIX THIS WATER PUMP.”</strong></td>
<td><strong>“TELL MY BOSS ON WHAT HAPPENED.”</strong></td>
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<td><strong>“NEED TO CHECK WATER MEASUREMENTS.”</strong></td>
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### FEELING

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### TOUCH POINTS

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<tr>
<td><strong>AQUAPONICS UNIT’S AQUACULTURE LEVEL (FIRST LEVEL) FISH TANK</strong></td>
<td><strong>WATER MONITORING UNIT</strong></td>
<td><strong>WATER MONITORING UNIT</strong></td>
<td><strong>HUMAN: TECHNICIAN</strong></td>
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<td><strong>SMARTPHONE</strong></td>
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<td><strong>SMARTPHONE</strong></td>
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IoT Network – Smart Shipping Container Aquaponics

- Each of the 15 aquaponics units in the urban farm is going to be fitted with IoT-enabled sensors.
- For any given unit, sensors are connected to SAP Cloud Platform via a wide area wireless network. SAP Leonardo receives data sent from the cloud, generating alerts on unusual measurements and populates data charts in the unit’s dashboard.
- Each unit has a sensor to measuring electrical energy consumption. At the aquaculture level (1) of each unit, the fish tank monitoring unit’s sensors measures water temperature, PH level, turbidity, oxygen level, and water pump flow. At the hydroponics level (2) of each unit, the sensor measures air temperature and air humidity.
- Goal: when problems occur on a unit, be notified immediately via alerts on mobile devices, so to take immediate actions on the unit.

Mockup I: Connected Goods Launch page – notifications on units needing attention

- Visit https://tinyurl.com/r7sbzy4 to access the prototype’s launch page.
- Display all 15 aquaponics units on this page, in 15 tiles. Each tile can have notifications.
- If a unit has problems, the unit’s tile will display “Needs Attention” in red.
- Click on a tile displaying “Needs Attention” opens the unit details dashboard page.
Hydroponics level
For hydroponics farm, the ideal plants growth air temperature for summer should be 75-85 °F during daytime (60-75 °F at night), with air humidity be 70-85% [4]. The first two column charts help her monitor to see if air temperature and humidity are within range:

1) Average Air Temperature (in °F)
2) Average Air Humidity (in %)

Aquaculture level (I)
Tilapia fish requires a water temperature of 75-90 °F [5]. The 3rd chart monitors:

3) Average Water Temperature (in °F)

Aquaculture level (II)
Of course, Tilapia fishes will die off when PH level is too acidic, when water oxygen level is too low, or the water is too turbid. If water pump flow is too low for too many hours due to bad circulation pump, water may become more acidic with low oxygen level. These 4 charts monitor:

4) Average Water Acidity (in PH)
5) Average Dissolved Oxygen (in PPM)
6) Average Water Turbidity (in NTU)
7) Average Water Pump Flow (in gpm)
Entire Unit
To regulate water and air condition within the entire “Shipping Container” aquaponics unit, this consumes some energy. The last chart near the bottom monitors the entire unit’s power consumption:
8) Average Power Consumption (in KWH)

Alerts
You can specify rules to determine when the unit should send alerts to your mobile device, via SAP Leonardo platform. For example, on “Average Air Temperature (in °F)” column chart, you can set rules such that anytime air temperature goes outside 75-85 °F, this sends an alert to your mobile device.

In another example, on “Average Water Acidity (in PH)” column chart, you can set rules such that anytime water PH level dips below 6, an alert notification will be send to your mobile device. Image blow is an example where alerts on water PH level has been generated, with an “Alert” red symbol at the column chart’s title:

Note for this prototype
For “Connected Goods Launch page”, only clicking the first 2 (Aquaponics Unit 1, Aquaponics Unit 2) tiles will open unit details page described in Mockup II. The 13 other tiles are currently inactive, so clicking them will not do anything.

Link for this prototype
https://standard.build.me/prototype-editors/api/public/v1/snapshots/d02ec46c3a1c09f40e0dd7a7/artifacts/latest/index.html#/launch_page

Source