Bore Pump Controller

Vision Document

**Change log**

This table lists the changes since LCOM.

|  |  |  |
| --- | --- | --- |
| Date | Author | Notes |
| 2020-06-06 | David | Removed a comment regarding IMS-band RF rules. |
| 2020-06-15 | David | Added title page and change log. |

# Introduction

The bore pump controller project was initiated by the Orange Agricultural Institute of the Department of Primary Industries NSW (DPI) to allow remote monitoring and control, plus automatic control, of a bore pump on their research farm in Orange, NSW. From here on DPI will stand for “the Orange Agricultural Institute of the Department of Primary Industries NSW”.

DPI has installed a water level sensor on the water tank the pump is connected to which is already used to monitor the water level in the tank. There is a dashboard to show the readings from this sensor and it can generate an SMS message for the farm manager when the level reading is low. The pump switches off when the outlet pressure is above a certain threshold as measured by a sensor in the pump.

The next logical steps are to allow the farm manager to switch the pump on or off remotely, and to have software monitor the water level and switch the pump on and off automatically.

A part of DPI’s mission is to encourage the use of technology in agriculture and this project may help farmers manage their water tank levels more conveniently and efficiently. There are existing solutions for remote control of pumps, but they are expensive and require the use of the mobile phone network so uptake by farmers has been low. By creating a solution that is based upon open source software and inexpensive hardware it is hoped more farmers will be tempted to automate their pumps to benefit from the convenience and efficiency this would bring.

In the future the project could be expanded to make use of the data gathered along with data from weather stations to make water use more efficient. That is not included in the scope of the project being delivered for ITC-303/309.

# Positioning

## Problem Statement

A manually operated pump is an inconvenience to the farm manager because they must visit the pump to switch it on in response water level alerts received via SMS. This is distracting and disruptive for the farm manager, requiring their attention and time for what is a relatively mechanical job.

A successful solution will allow the farm manager to ‘let the pump take care of itself’ and only get involved when an unusual condition is flagged by the pump management software.

Other farms may not even have the ability to send SMS alerts in response to water level readings meaning the farm manager must visit the water tanks to see if they require filling.

## Product Position Statement

|  |  |
| --- | --- |
| For | Farm managers, initially at DPI for trials, then for other farms. |
| Who | Must monitor water levels and control bore pumps. |
| The Bore Pump Controller | Is a bore pump automation system with both monitoring of water level and automatic control of the pump. |
| That | Will free up the farm manager’s time from regularly checking water levels and switching pumps on. |
| Unlike | Other commercial alternatives that are expensive and require mobile phone network connectivity which is not always available on a remote farm. |
| Our product | Is low cost being based upon open source software, inexpensive hardware, and a radio frequency communication mechanism that can be set up on a farm by the farm manager. |

# Stakeholder Descriptions

## Stakeholder Summary

| **Name** | **Description** | **Responsibilities** |
| --- | --- | --- |
| Farm manager | The farm manager may own the farm or may be employed by the farm owner to run and manage the farm. | In the context of this project the farm manager must monitor water levels in dams and tanks and must control bore pumps to maintain those levels. |
| DPI | Project sponsor | DPI have a bore pump on their own research farm and have decided this would be a useful system for them to have.  DPI also has a mission to find ways to make technology useful and available to professional farmers to make running a farm more efficient in both time and resource usage, such as improving water usage and reducing waste. |
| The IT Crowd | The IT crowd have agreed to develop the bore pump control system as the capstone project for their Computer Science degree. | End to end specification, development, and quality control of the software.  The IT Crowd will work with DPI to integrate with existing sensors and infrastructure during development and assist in on-site integration and testing if required.  The IT Crowd will deliver a system that is fit for use and suitable for further development. |

## User Environment

Part of this system is a controller attached to a bore pump. It will be housed in the pump’s electrical cabinet.

The UI is expected to be usable on mobile phones, tablets, and desktop computers. This will be implemented on the Thingsboard IoT dashboarding platform. DPI have Thingsboard hosted at a data center in Sydney.

The existing water tank level sensor and the new pump controller will communicate with the Thingsboard control and storage tier via LoRraWAN messages routed through The Things Network.

# Product Overview

## Needs and Features

|  |  |  |  |
| --- | --- | --- | --- |
| **Need** | **Priority** | **Features** | **Planned Release** |
| Remote control of the pump. | 1 | A UI element to allow the farm manager to switch the pump on or off. | 1 |
| Automatic control of the pump. | 1 | Software rules to switch the pump on or off in response to water level sensor readings. | 1 |
| A means to review all pump activity and water level readings | 1 | A dashboard showing this information. | 1 |
| Awareness of potential problems with the pump. | 1 | Dashboard alarms raised in response to potential problems such as no pump state change after an on/off message was sent. | 1 |

# Other Product Requirements

DPI have specified the following hardware and software platforms as they are already in use at the department:

* The pump controller will run on an Adafruit Feather M0 LoRa 900MHz board.  
  https://www.adafruit.com/product/3178
* The water level sensor is in place. The sensor is an Ellenex PLD2-L.  
  https://www.ellenex.com/lorawan-level-temperature-sensor
* The Things Network is used for sensor data transmission.
* Thingsboard will be used for data storage, message processing, and UI.
* The Thingsboard server is hosted in a data center in Sydney for DPI.

User authentication is required and is provided by Thingsboard.

Encryption of the LoRaWAN messages is provided by the protocol used by The Things Network, and TLS encryption between The Things Network and Thingsboard.

The 900MHz RF bands are for public use but the amount of transmissions permitted within a given time are limited by both government regulation and The Things Network terms of service. The Things Network has a “duty cycle” of 1% and a fair access policy that restricts uplink airtime to 30 seconds per day per node and 10 downlink messages per day per node.

Due to the data transmission constraints mentioned above, the communication protocol between the pump controller and the server-side software must not require ACKs for messages. The business rules must take into account the fact that messages may be lost in either direction.

The code will be licensed as open source. DPI will decide upon the license after delivery of the software.