Crown Agriculture Solutions

Farming made simple

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June 9, 2019

Dr. Andrew Rawicz
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Re: Requirements Specification Documentation for Crown Agriculture Solutions

Dear Dr. Andrew Rawicz:

The attached document, Requirements Documentation for Crown Agriculture Solutions, details the functionality in conjunction with the requirements followed in developing "Costless Node Network" or CNN by Crown Agriculture Solutions or CAS. CAS' goal is to significantly enhance crop yield at a fraction of the cost to the farmer further making farming effortless. CAS' first product is CNN. CNN is a network of sensors spread throughout the farm providing the farmer necessary data thereby significantly improving crop yield.

The Requirements Document is to provide an exhaustive list of the functionality in conjunction with the requirements followed in developing CNN. Requirements and functionality are provided for the proof-of-concept, the prototype, and production stages. Requirements document shall be utilized as the benchmark for all CNN development stages.

Crown Agriculture Solutions is operated by an innovative marketing personnel with a broad skill set to design and produce customer focused products. This capstone project proposal is prepared in partial completion of the graduation requirements at the Simon Fraser University in the Engineering Science program.

If you have any questions or concerns regarding my proposal, please feel free to contact me by my direct line at (778) 840.8462 or via email at mike_saad@sfu.ca

Sincerely

M.Saad

Crown Agriculture Solutions

Farming made simple

Requirements Documentation for

Crown Agriculture Solutions

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Submitted To

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Prepared On June 9, 2019

ABSTRACT

Famers abroad know very little about the various needs of different areas in the farm. Consequently, annual yield is poor. Further the average farmer needlessly spends folds annually on irrigation as well as every aspect of the farming process from seed to harvest.
CAS has formulated a comprehensive solution to solve all aforementioned problems encountered by farmers. CNN helps farmers generate quality crop from almost every seed planted by empowering the farmer with the tools necessary to do so. Further CNN will cut all costs to only a small fraction. This means superior quality crops, higher percentage yield, at a negligible fraction of the costs!
This Requirements document details an exhaustive list of functionalities in conjunction with requirements utilized as guidance during development of CNN. Enclosed are functional paired with non-functional guidelines for proof-of-concept, prototype, and production stages. The intent is an outline to investors including a comprehensive package of requirements followed and standards adhered by during the development of CNN

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Introduction/Background

Project goal is to engineer a way to extract information from a farm with an effortless and productive manner. Collected data is intuitively presented to the farmer to enhance their crops. The type of data, volume of data, speed of access, will be the deliverables for this project. Project background stems from the laborious task of farmers to manually and visually judge and collect data and this leads to inefficiency, poor and limited access to data, as the size of the property increases. CAS' goal is to minimize physical efforts to collect data with initial capital cost and maximize productivity for the farmers.
CNN is a comprehensive solution to all the challenges faced by farmers across the globe. Farmers suffer from low yielding and increasing costs to the point that most barely breakeven. CNN's primary goal is to reverse this experience by providing high resolution data and take control of the crops and expect healthy yield year after year. Using CNN means deploying a method which leads to a very healthy crop yield at a very low cost. Furthermore, CNN means a significant reduction in tedious labour.

Scope

This Requirements document details an exhaustive list of functionalities in conjunction with requirements utilized as guidance during development of CNN. Enclosed are functional paired with non-functional guidelines for proof-of-concept, prototype as well as production stages. Further is an Alpha phase Acceptance Test plan

Intended Audience:

Intended audience of this requirements documentation include the proprietor, financing institution, legal representative body, and examining professors.

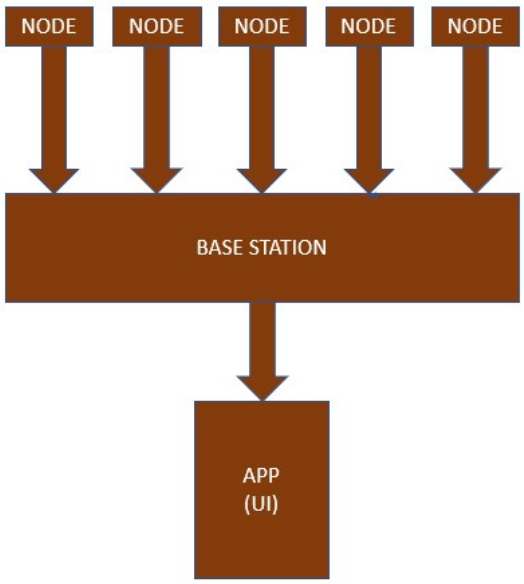
Glossary:

Requirements and deliverables are to be classified in three stages as follows:

I – Alpha phase of development – Proof of Concept prototype
II – Beta phase of development – Engineering prototype
III – Production

System Overview:

CNN helps farmers generate quality crop from almost every seed planted at a negligible fraction of the costs. Once farmer starts the App, the latest report from the base station is accessed. The App configures the UI according to the report. UI supplies the farmer with a map and an action plan to minimize effort. The report is constantly updated by nodes thereby enabling the base station to present accurate data. Nodes communicate with base station every hour.



System Overview: High Level Communication Diagram

System Requirements:

During the alpha and beta phases CNN is proven for the base case and thereby validating the expansion into full production.

General Requirements

III Cost of node should be under $1 USD for feasibility purposes to farmer due to the large volume of nodes necessary for a commercial farm
I customer is farm owner
III Node density per acre varies between 50 to 100 nodes contingent to crop type
III Farm size considered is 1000 hectares as this is typical for commercial farms.
I Nodes will be in an outdoor environment
I Base Station will be in an indoor environment

Performance

I Report is continuously updated and accessible to farmer thereby delivering a current version of the report to farmer
I farmer decides upon method of viewing report as this is most convenient thereby generating customer referrals.

Electrical Requirements

I Node is powered by non-rechargeable batteries as this is the most cost-effective option.
III batteries must endure up to three years of service without replacement as node replacement is quite tedious.
III Node is expected to endure up to three years of service without any maintenance. After a three-year period, CNN would have evolved into a very lucrative upgrade thereby avoiding maintenance through replacement.

Reliability and durability

I Node is wind and rain resistant.
I Node able to withstand a storm by depth in soil robust Architecture
III Product can function in all seasons and temperatures across North America
II Frequent firmware updates to avoid errors

Usability

II User interface is powerfully intuitive to the simplest user as farmers are not computer savvy
II UI creates an environment delivering a procedure for effortless tasks.
III The product is easily scalable to different farm sizes more minimum costs
II User manual will focus on rare situations and focus less on the norm as to not confuse farmer
III Should an issue arise, customer will contact CAS via text or email. Customer is

only required to provide location of farm and preferred contact information.

III farmer will be asserted of a phone response same day thereby cutting employee costs.

III CAS will send a technician in response to customer inquiry as excellent customer service will incur further referrals.

Hardware Requirements

Enclosure

I Alpha phase shall have a plastic enclosure in shape of pole as metal will interfere with communication and wood will decrease signal strength at source.

II Beta phase enclosure shall include all node parts. Only sensor will be exposed

II Pole height will vary between 1’ to 3’ as this is desired for antenna length.

node:

I At pole bottom is a soil sensor. Sensor depth in soil is crop dependent.

I Batteries are strategically placed above sensors for low center of gravity and wind resistance

I Microcontroller will be placed above batteries

I Antenna is placed at top of node

Microcontroller

II node communication with base station will be using mesh networking paired with direct communication to facilitate farm size

III Network should be capable of up to 3 km range between node and base station

I mesh networking concepts will be paired with standard of choice to support simultaneous communication between all nodes in farm and base station(s)

I Microcontroller wakes up, reads sensor, sends report to base station and shuts down. Such a process will be done as quickly as possible to minimize power and time.

I described process should be completed for all nodes in farm in less than an hour

II process should complete under 2 seconds in order to deliver a full report as defined.

I low power consumption is not of the essence as node awake time is insignificant

Batteries

I must be most cost-effective option delivering maximum power
III must endure up to 3 years of service without any maintenance
I Non-rechargeable as this is the most cost-effective option

Antenna

I An Antenna will be connected to every base station and node.
III Antenna network must deliver clear connection across a 1000-hectare farm.
I Antenna height will be a maximum of 1 meter for clear signal across farm

Moisture sensor

I Sensor threshold for distress beacon is a drop of soil moisture by 20% as soil moisture level should be greater than 80% for all soil types.
I Sensor uses capacitive sensing to measure soil moisture as resistive sensor rusts
I when farmer irrigating zone corresponding to node, node will assert completion to farmer when sensor reading is back at 100% as feedback is important for novice users such as farmers.

Software Requirements

Application:

II Due to time constraints, only an android app will be created.
II App will be programmed using a language that is the most cost-effective in engineering hours and most time-effective in code run time.
II App is readily available to customers via website for download as this is the most cost-effective option of App access
II Updates will be conducted seamlessly as to not cause annoyance.
II Report is accessed by farmer within 3-5 seconds of request as a long delay in access will create impatience towards app thereby losing a customer.
II Base Station generates action plan for farmer

Base Station:

III microprocessor should be capable of high volume of data and computation
II microprocessor should be quad core with at least 1GHz.
III Two or more base stations due to high volume of nodes

A redundant base station is present in case of a main base station failing

I Capable of capturing a report from all nodes in less than an hour. A lengthier time frame may cause crop damage.

III Can communicate with all nodes simultaneously. Node density relies upon type of crop

I Acquires data from 5 nodes and displays report on screen

Engineering standards

II The product must conform to IEC 61508 standard for functional safety of electronic safety-related systems

III All materials used in the product must comply to Restriction of Hazardous Substances Directive (RoHS)

II The product must conform to the IEEE 802.15 standard for Bluetooth communication

III The product must conform to the RSS-210 radio-communication standard

I The product must be in compliance with IEEE 139-1988 standard for not producing any harmful radiation from wireless or radio components

Safety

Safety is ensured in CNN via consistent firmware and software updates paired with hardware redundancies. CNN boasts a robust system in every aspect. Thereby guaranteeing data accuracy and precise farmer action.

I Plastic Node enclosure must not have any sharp edges that could potentially harm an animal and thereby leaving a rotting carcass in the field.

II Node enclosure material must be such all components do not experience heat-damage in all North America weather conditions

I All parts in node must be moisture insulated except sensors

I The node must be secured to the soil for wind other weather-related situations

II firmware check conducted every 24 hours. Node firmware is overwritten by clean version of firmware from base station. Firmware updates create less probability of hardware damage

II software checks are seamlessly conducted on the base stations approximately every 10 hours.

Sustainability

- Minimal number of batteries will be used
- Batteries will be disposed of in an environmentally friendly fashion
- Nodes will be equipped with new batteries and resold at a much more feasible price.
- upon three-year term completion, Farmer is expected to upgrade to a much more lucrative version of CNN
- Old nodes will be collected from farmer with royalties towards new system.
- Nodes will be sold outside North America as the technology is outdated.

CONCLUSION

Farmers have been faced with many hurdles since the beginning of civilization. Such hurdles are surprisingly contradictive. Farmers at times dispense much larger volumes of water than is needed by plants and thereby incurring needless costs. On the contrary, a considerable issue is the drying of plants.

CAS's first, of many, innovation, CNN, addresses such issues by informing the farmer of the amount of water necessary in the area surrounding each node thereby cutting hydration costs as well as ensuring plants will not be dehydrated.

CNN is the first existing solution in the market with such a powerful package to ensure a rich crop yield paired with cutting down unnecessary costs. CNN is a combination of low power nodes enhanced with low bandwidth technology requiring minimal Engineering hours combined with a powerfully intuitive User Interface making CNN a lucrative solution to the farmer at first glance. CAS aims to continue to innovate CNN and to tailor it to meet every farmer's needs. Thus, driving CNN into every farmer's hands across the globe!

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ALPHA PHASE TEST PLAN APPENDIX

Setup	Acceptance status	Acceptance Requirements
Pot next to base station	Yes ____ No ____	Reading from sensor in pot matches report displayed on screen attached to base station
Base station in front of C9001 and 2 pots in front of B9200. 1 pot with extremely moist soil and the other pot with dry soil	Yes ____ No ____	Base station can correlate each node report with its node ID
Base Station in front of C9001 and node in front of AV	Yes ____ No ____	Such distance should not create latency.
Five nodes distributed across varying distances from base station in a line-of-sight environment. Each node contains different soil moisture level.	Yes ____ No ____	Base station can print on screen distance and soil moisture level of each node.
A full report should take between 5-7 minutes since there are only 5 nodes.	Yes ____ No	Report is complete within time limit
Report is constantly updating	Yes ____ No	There should be no pause between updates.
Report should display on screen within 3-5 seconds of user request	Yes ____ No	A delay greater than 20 seconds is a fail.