Implementing Artificial Intelligence In Precision Farming

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***Abstract*—Besides the three classical production factors land, labor and capital, the factor "information and knowledge" becomes more and more important. As the result of information technology application in agriculture, precision agriculture is a feasible approach for sustainable agriculture Since the amount of arable land in countries is shrinking we have to concentrate on the better employment of knowledge and technology. This paper gives a primary summary of precision agriculture for India and a brief introduction of the practice in India. By summarizing the researches and conceiving on precision agriculture, this paper explains the generality of precision agriculture with Artificial Intelligent Systems for which it aims to provide the reference and gist for those who are interested in. The generality includes concept, composition, classification, methodology and the technology systems of Artificial Intelligence with agriculture. Artificial Intelligence precision agriculture technologies are regarded as three parts: the fundamentals, the engineering and the supporting. The fundamentals are composed of index system for precision invest, technology integration, digital and virtual technology.. This paper also gives the strategies to construct precision agriculture in India, introduces some researches and conducting cases to show the progresses in India. Artificial Intelligence in Agriculture. Especially for the Artificial Intelligence, this context reveals a variety of high-potential technologies to be applied, as the agricultural and environmental domains provide a steadily growing pool of publicly accessible knowledge, which is financed and maintained from governmental organizations. Innovative AI technologies can significantly contribute to organize, connect, and further develop this knowledge in order to better supply the collective demand for food.**

Keywords— precision agriculture; practice; theory; technology, composition, automation, controllers, computer vision, agriculture

I INTRODUCTION

Precision Agriculture (PA) or satellite farming or site specific crop management (SSCM) is a farming management concept based on observing, measuring and responding to inter and intra-field variability in crops. Crop variability typically has both a spatial and temporal component which makes statistical/computational treatments quite involved. The holy grail of precision agriculture research will be the ability to define a Decision Support System(DSS) for whole farm management with the goal of optimizing returns on inputs while preserving resources. The reality today is that seemingly simple concepts such the ability to define management zones, areas where different management practices will apply, for a single crop type on a single field over time are difficult to define these include hand drawn polygons on yield maps, supervised and unsupervised classification procedures on satellite or aerial imagery, identification of yield stability patterns across seasons, etc. Among these many approaches is a phytogeomorphological approach which ties multi-year crop growth stability/characteristics to topological terrain attributes. The interest in the phytogeomorphological approach stems from the fact that the geomorphology component typically dictates the hydrology of the farm field. Multi-year datasets are now becoming available that show this stability and these effects however, there is a lot of work remaining to create an actual DSS system that could universally help farmers. PA is based on the development and use of new technologies including new computerized equipment and information management systems for more effective crop production and environmental protection. It targets inputs and management practices to variable field conditions such as soil/landscape characteristics, pest presence and microclimate. Unlike traditional crop management, which assumes uniform field conditions and recommends average input application rates, it is an information intensive approach. A more holistic agricultural approach, PA uses information technology to bring data from multiple sources to bear on decisions associated with agricultural production, logistics, marketing, finance, and personnel.

However, in view of different situation from western countries, in China the formulation of PA that Precision Agriculture is the modern agricultural management manner equipped with digitalize techniques, ITs, intelligent techniques and VRT. Here agriculture includes cropping, forest, fruit, husbandry, fishery, and so on. It aims for sustainable agriculture development by optimize invest of materials,

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lowest consumption of natural resource, poor environment pollution and high quality and production.

II AUTOMATION

In semi-professional literature, automation in water management are considered as one entity. For the sake of accuracy it has to be clarified that this is not accurate. Automation can be implemented independently from each other. Actually, the combination of both amplifies the contribution of each technology to water use efficiency.

The development of automation in irrigation commenced in the mid-fifties of the 20th century and gained momentum in the sixties.

Automation in irrigation is classified in two categories:

1.Automation on time basis – using timers for opening and shutdown of valves.

2.Automation on volumetric basis – automatic shutdown of the valves after a preset volume of water had been delivered.

The automation of irrigation promoted higher levels of sophistication as well as comprehensive services beyond automation, like water supply and irrigation network design, water budgeting, scheduling of irrigation timetables, real time operating systems. Beyond agricultural irrigation, automation are extensively used in water supply networks, landscape irrigation, municipal household consumption and monitoring.water allocation.

Automation can be classified according to the extent of water application control.

• Point automation: an automatic device mounted directly on one valve, controlling exclusively this valve with no relevance to other valves or systems.

• Local automation: Several valves in a plot controlled and coordinated by one unit.

• Central automation: Local automation units that are connected to and controlled by a central unit.

Automation can be implemented in diverse levels of sophistication.

• Shutdown of water flow after the application of a preset amount. Valve opening is done manually.

• Time-based automatic opening and shutdown of the water.

• Opening by timer, automatic shutdown after a preset water amount had been delivered.

As above plus feedback and recording of the delivered water amount.

• Combined irrigation and fertilization (fertigation), with or without recording of the applied water and fertilizer amounts.

• Sequential activation of valves in the plot.

• Irrigation Control adjusted in real-time by information about temperature, wind, rain, soil moisture, water pressure, etc., received from sensors.

• Control of water sources in correspondence with water demand by consumers.

• Integrated control of water sources and irrigation systems.

• Integrated scheduling and control of irrigation systems.

Automation systems facilitate full exploitation of the potential of automation.

A. Controllers

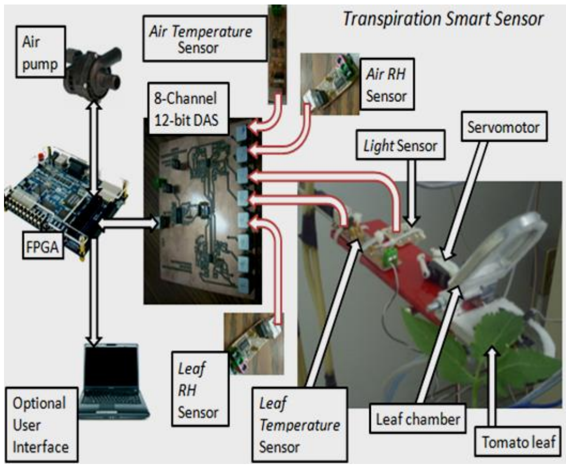

Fig1: electronic set up for precision farming

The early automation devices were composed of mechanical gear interfaces that were mounted on ordinary flow meters or clocks that were converted to timers that controlled the automatic valves, hydraulically or electrically. The hydraulic valves stopped water flow by means of a piston or a flexible membrane movement, activated by signals of the inherent hydraulic pressure of the water in the irrigation system. The electric valves were opened and closed by electric signals sent to solenoids. The incorporation of ICT increased the sophistication of automation and reduced the operative costs. Programmed controllers of the first generation were bulky and complex. Programming was done manually by shifting mechanical switches and required qualified professional programmers. Gradually, Programmable Logic Controllers (PLC) and standard industrial microcomputers replaced the first generation of controllers, facilitating the use of "off the shelf" software for the management of irrigation. One central unit can nowadays control hundreds of local satellite field units.

B. Fertigation Control

In advanced irrigated agriculture, fertilizers are applied with irrigation water by fertigation technology. Precise dosing of the fertilizers in a pre-defined ratio to the irrigation water is carried out by various types of fertilizer injectors that are synchronized with the applied water amount by controllers. Water flow rate is measured by flow/water meter and the fertilizer solution flow rate is measured by counting the pulses of the fertilizer pump or by dedicated small flow meters. The information is sent to the controller that regulates the ratio between the irrigation water and the fertilizer solution. In intensive agriculture in greenhouses, nurseries and detached beds, the ratio of water – nutrients and the ratio between the different nutrients are adjusted according to feedback from sensors that measure the EC and pH levels in the drainage

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water.In highly sophisticated greenhouses, the fertigation control is embedded in a comprehensive control system of the environmental parameters like temperature, light, aeration, relative humidity, etc. inside the greenhouse. Future development seems to branch in two paths: Higher sophisticate comprehensiveness in the greenhouses sector.

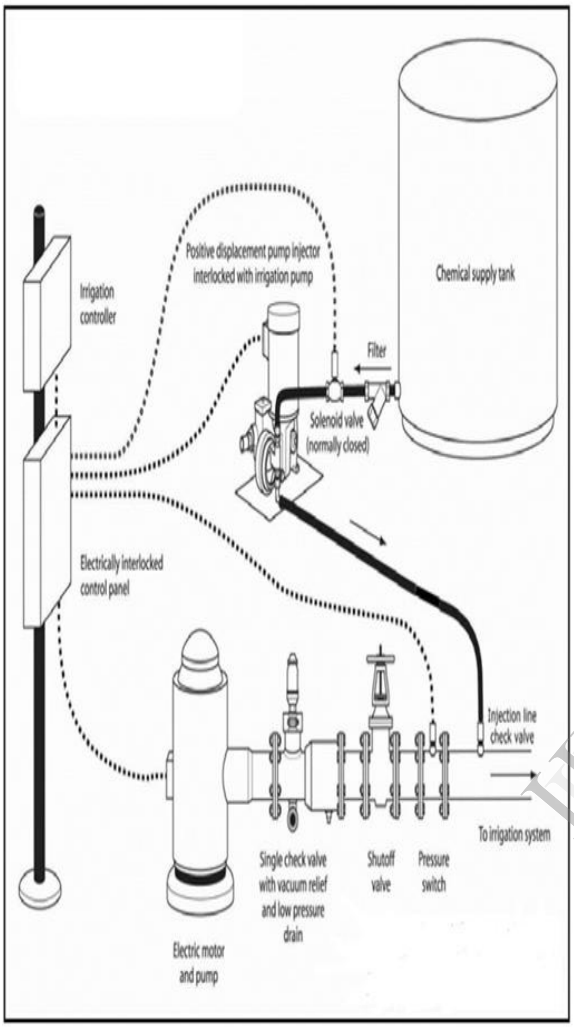

Fig2 :- fertigation technique

- Wide scale dissemination and expansion in open field agriculture, relying on soil and crop nutrient level measurements.

- The system deviations from the accepted range send alert signals to the operator and/or suspend the water application until the correction of the malfunction. Common identifiable system failures that cause water losses and decreases water distribution uniformity are pipe breakage; multiple emitters' clogging and pressure fluctuations.

- Automation has a particular contribution to filtration of irrigation water. In water contaminated by sand, clay and organic debris; arrays of automatic centrifugal or media filters are flushed automatically. Timing of flushing is determined on time basis or by preset allowed pressure difference between the inlet and the outlet of the filter. The automatic flushing of the filtration systems prevents pressure and flow fluctuations in the irrigated plots, due to filters clogging.

- Controllers operation requires energy sources. These may be the inherent hydraulic pressure of the irrigation system or electricity from AC network or declining prices and increasing reliability of that technology.

III RULES FOR DECISION-MAKING

This category refers to the knowledge that supports the decision-making process. This knowledge is represented as a set of rules, which are used for various decisions. We mention below some of them.

A. Sensors.

A design principle of our approach is to abstract the system from the real sensors that we are using. Specifically, if we assume that a sensor measuring the temperature provides to the system a value within a specific range, we can use any available sensor and with a set of rules we can calculate the value that the system recognizes from the sensor's outputs.

B. Diagnosis of the plant state

There is a need for a set of rules that will take into account both plant and environmental parameters and the description of a plant to diagnose a plant's state.

C. .Local Decision-Making

The local decision-making is based on a plant's state and its description determines the possible actions of an ePlant, like the request for a resource.. For energy-efficiency and power consumption considerations, the sensor nodes are reporting data once per 5 mins. The data collected by the sensor nodes is gathered by the hosting node, for local processing and logging. Interaction then is possible between the hosting node and other devices for managing the delivery. Heat stress can occur independently of water stress when the ambient environmental temperature gets very high and plant transpiration cannot maintain leaf cooling. Therefore, if the plant has adequate water (determined by the SM probe) but the plant temperature is high this means that it is heat-stressed and requires misting to cool it. However, if the temperature is high and the moisture content low, then pot irrigation is required. The CF and AL parameters are used to determine photo-oxidative stress and adjust supplementary light.

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Table 1: Application rules with confidence factor

s.no.	**Rule**	**Body**
1	RC Drought Stress [CF=0.8]	IF RC Avg Temp–Ambient Avg Temp>0.7□C [CF=0.9] THEN RC Drought Stress □TRUE ELSE RC Drought Stress □FALSE {CF=0.72}
2	RC Heat Stress [CF=0.9]	IF RC Drought Stress {CF=0.7} AND RC Avg Moisture>60% [CF=0.9] {CF=min(0.7, 0.9)=0.7} THEN RC Heat Stress □TRUE ELSE RC Heat Stress □FALSE {CF=0.65}
3	RC Need Irrigation [CF=1]	IF RC Drought Stress {CF=0.72 } AND NOT RC Heat Stress {CF=0.65 } {CF=min(0.7, 0.65)=0.65} THEN RC Need Irrigation □TRUE ELSE RC Need Irrigation □FALSE {CF=0.65}
4	Need Misting [CF=1]	IF RC Drought Stress {CF=0.72 } AND RC Heat Stress {CF=0.65} {CF=min(0.7, 0.65)=0.65} THEN Need Misting TRUE ELSE Need Misting □FALSE {CF=0.65}

IV PROTOTYPE SETUP AND EVALUATION

The prototype setup consists of an array of 100 plants placed in a glasshouse, arranged in an array of 20 by 5. The setup consists of four different zones: Left-Edge (LE), Right-Edge (RE), Left-Centre (LC), Right-Centre (RC) and also one zone specified for misting, which coincides with the RC Certainty factors may apply both to facts and to rules, or ather to the conclusion(s) of rules. Conditions for rules are formed by the logical 'and' and 'or' of a number of facts. The certainty factors associated with each condition are combined to produce a certainty factor for the whole condition. For two conditions P1 and P2, it holds that: CF(P1 and P2) = min(CF(P1), CF(P2)) and CF(P1 or P2) = max(CF(P1), CF(P2)). The combined CF of the condition is then multiplied by the CF of the rule to get the CF of the conclusion.

Fig3:-Low Cost Fertigation Technique

On the agronomic part of the experiment, the instrumentation of the apple field with the wireless sensor network and the plant-driven irrigation leads to a notable reduction in water consumption (16–20%) with respect to traditional agricultural practices involving user-defined timed irrigation based on rules of thumb. The latter was applied in a parallel setup for the same growing period (early development stage) of the crop. The deployment of smart water management on a large farming scale is extremely important, given the irrigation needs of the agricultural sector (irrigation uses up to 80.0% of total water in some regions) and the decreasing availability of water for irrigation.

V RELATED WORK

Attempts to use environmental sensor networks to improve crop cultivation by monitoring and reporting on the status of the field are reported by Burrell et al. (2004) and Zhang et al. (2004). These approaches provide decision-support to the user who responds by providing the required treatment. This is in contrast to our plant-driven distributed management system that imposes a proactive-computing model for the crop treatment In the biology, botany, organic computing and bioinformatics domains, there are activities on building ontologies that partially address principles of PLANTS (The Plant Ontology Consortium, http://www. plantontology.org; Sequence Ontology, These activities aim to develop and share structured controlled vocabularies for plant-specific knowledge domains like plant anatomy, temporal stages, genes and biological sequences.

VI CONCLUSION AND FUTURE WORK

We have been involved with a facet of precision agriculture that concentrates on plant-driven crop management. By monitoring soil, crop and climate in a field and providing a decision-support system, it is possible to deliver treatments, such as irrigation, fertilizer and pesticide application, for specific parts of a field in real time and proactively. In this context, we have presented in this paper an ontology-driven determine accurately significant thresholds of plant-based parameters and for extracting new knowledge and extending the PLANTS ontology. By providing intelligent decision-making, we have been exploring ways of incorporating learning capabilities in the system. Machine-learning algorithms (Mitchell, 1996) can be used for inducing new rules by analyzing logged data sets to determine accurately significant thresholds of plant-based parameters and for extracting new knowledge and extending the PLANTS ontology. By providing intelligent decision-making, we can replace the typical, explicitly coded actions to situations and (which can only prescribe a fixed set of predicates) with a multi-level and more knowledge -intensive decision-making framework coupled with reasoning under uncertainty and machine-learning techniques. Both supervised (experimentation-driven or user-mediation) and non-supervised learning algorithms are needed for realizing the self-regulation properties of the system that goes beyond the usual distinction of closed vs. open adaptive systems

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