A REPORT

ON

AUTOMATING IRRIGATION SYSTEMS AND ACQUIRING DATA USING SCADA

BY

SAGAR AGARWAL **2015A7PS0314U**

AT

International Center for Biosaline Agriculture, Dubai
Dubai, UAE

A Practice School – II Station of

BITS Pilani, Dubai Campus
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(AUGUST 2018 - JANUARY 2019)

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SAGAR AGARWAL 2015A7PS0314U COMPUTER SCIENCE

Prepared in Partial Fulfillment of the
Practice School – II Course

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Abstract: This project report provides an orientation of the organization and gives an insight into automation. This project report also deals with the various aspects that need to be considered when a process is automated. Given inside are the details about the SCADA system and its crucial components that one should be familiar with.

Signature of the Student Signature of PS Faculty

Date: Date:

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Signature of the Student

Date:

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INTRODUCTION

1.1 OVERVIEW OF ICBA

Figure 1.1 – ICBA

1.1.1 HISTORY

In the year 1992 new initiatives were discussed under the consulting board of the IDB to outline certain objectives and activities for a new institution, and in November it was approved for financing this startup. Figure 1.1 is the logo of this organization. Over the course of coming years, there were meetings between Bank and General Secretariat for GCC to select United Arab Emirates as the headquarter of this new organization.

The year 1996 marked the formal establishment of this organization, ICBA and a mutual agreement was signed between the Bank and the Government of the United Arab Emirates. The Arab Fund for Economic and Social Development and the Organization of the Petroleum Exporting Countries provided the monetary support needed. In the year 1997, 100 hectares of land was subsequently donated by the Municipality of Dubai at Al Ruwayyah for the head office of ICBA.

1.1.2 MISSIONS AND VISIONS OF THE ORGANISATION

Integral and Professional Values:

At ICBA the main goal of the people is to do their work with pure honesty and do every task with responsibility. Their main aim is to provide their stakeholders with quality assured service and make sure they reach up to their full potential when it comes to research-based projects, communicating, managing tasks and operations

Team efforts and the Partners:

At the organization the priority is given to team efforts, the mutual understanding and sharing of resources and knowledge with the partners to develop the required strength. They have mutual respect for people they share professional work with. Their consulting team constantly reaches out to new partners to work with and achieve their promised missions.

Innovating with excellent ethics:

They promise to promote cultural innovations and are always working on ways to improve upon the existing individual partners and organizations to achieve the mission.

Relations with People:
The organization prioritizes the importance of relationships between coworkers and the changes that may occur over time. It also enhances and believes in making their employees as partners to successfully achieve every mission they undertake. The organization also promotes to make the existing relationships strong, maintaining and restoring the well-being of everybody working.

1.1.3 RESEARCH THEMES

The organization mainly prioritizes the research that is required to be put in place for security of food and nutrition for the generations to come. It also further targets to work on water quality and improve the existing water crisis situations. Lastly it aims in making the marginal environments more profitable.

Since its founding in 1999, ICBA has become a reference and a global Center of Excellence for innovative agriculture in saline and marginal environments. The research themes are shown in Figure 1.2. The organization has put forward the idea of assigning scientists to work upon these issues. These scientists work to figure out ways on how to improve upon security of water and nutrition and deliver the results.

Figure 1.2 – Research Themes

1) Natural Resources Assessment & Management
    i. Resources and Uses
    ii. Soil Management
2) Climate Change Impacts and Management
    i. Regional and country-level predictions of change on climate, water and crop production
    ii. Adaptation solutions in water, cropping and policy ideas
3) Crop Productivity and Diversification
    i. Salt-tolerant Crops and Halophytes
    ii. Plant Genetic Resources
    iii. Molecular Biology
    iv. Crop Modeling
4) Aquaculture and Bio-energy
5) Policies for Resilience
6) Special Initiatives
    i. Knowledge Hub
    ii. Women Scientists and Leaders Program
    iii. Alliances
    iv. Technology Incubator
    v. Young Arab Women Scientist Program

1.1.4 SOLUTIONS

- ✓ Research in applied fields
- ✓ Resilience focused policies
- ✓ Intensive focus on technology-based innovations
- ✓ Figure 1.3 shows us the countries of their work
- ✓ Innovation oriented partnerships by Private Sectors
- ✓ Assistance for technical roles
- ✓ Knowledge creation
- ✓ Build and further train the existing capacities

Figure 1.3 – Solutions

1.1.5 WHERE THEY WORK

Figure 1.4 gives us the detailed insight about their intensive work areas and Figure 1.5 gives us information about land degradation around the world.

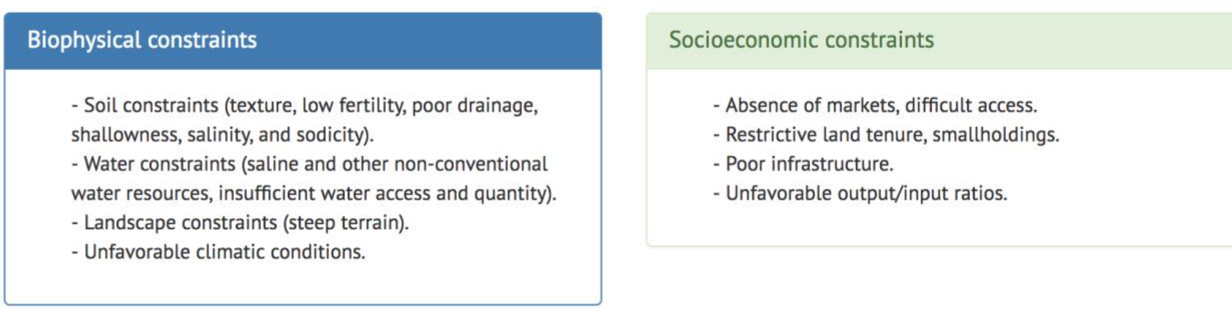


Figure 1.4 – Where they work

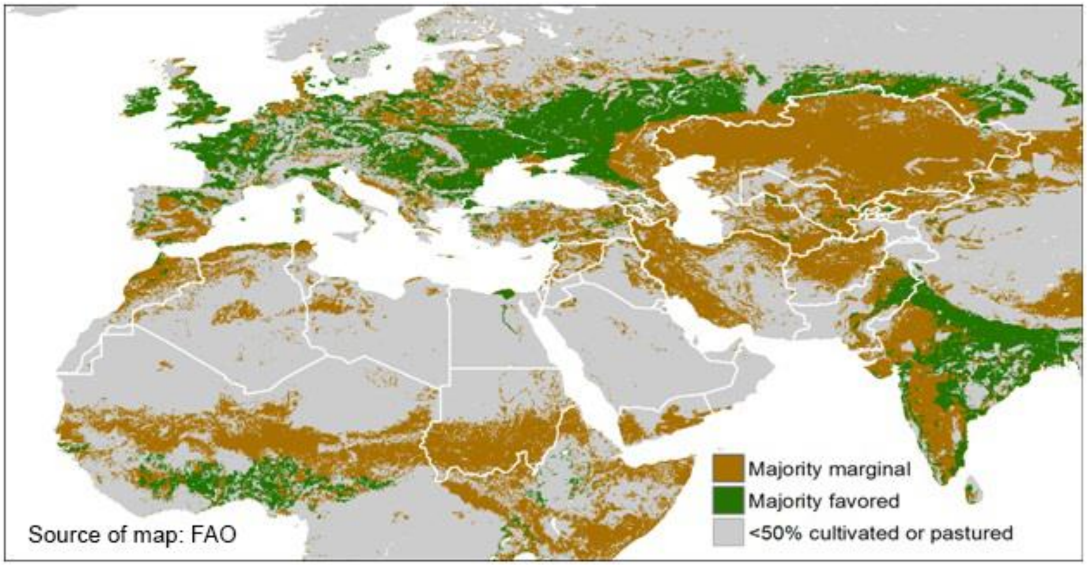


Figure 1.5 – Land Degradation

CHAPTER 2

IRRIGATION

2.1 IRRIGATION

In simple terms irrigation can be described as an efficient way of artificially providing water to the plants. The technique dates back to the days when humans realized the importance of watering the plants. In olden days people would use buckets to water the plants, while this practice is still in practice, new and better methods have been invented for doing the same. With all the new methods, traditional ones are far more common than the modern ones.

In present day conditions with water scarcity everywhere especially fresh water, people need to use it carefully while keeping sustainable development in mind. Figure 2.1 shows one such way of irrigating the plants, where the plants are watered carefully with minimal wastage.

Figure 2.1 – Irrigation

2.2 TRADITIONAL IRRIGATION METHODS

- C-Basin.
- Furrows.
- Strips.
- Basins.

2.3 MODERN IRRIGATION METHODS

- Sprinklers.
- Drips.
- Pots.

2.3.1 SPRINKLER IRRIGATION METHOD

This is the latest method put into working in most places in the recent times, with installing pipes throughout the field for watering. This method has been proved effective for regions with water scarcity and high temperature to maintain the humidity scale. This method has resulted in efficiency rate increases from roughly sixty to about ninety percent.

The method can be installed in the following ways:

- Permanent.
- Semi-permanent.
- Temporary.

The permanent method requires the pipes to be installed in the fields permanently, and once the blue print of the pipes is laid down, the installed pipes cannot be shifted from one place to another. The pipes which are laid underground are considered to be safer in comparison to the ones that are laid on the fields which are always prone to breakage. This method is recommended for canal irrigation systems that claim to be areas with water scarcity.

The second method is known as the semi-permanent, and as the name suggest the pipe layout plan can be either a permeant solution or temporary one depending upon the situation and circumstances. The main pipes are preferred to be installed underground whereas the branch pipes are over the ground so that changing their place becomes easier in case new areas are to be irrigated that weren’t on the plans earlier.

The temporary method is as simple as it sounds, both the source and the branch pipes are placed over the ground and removed to new locations if and when required.

However, there are some disadvantages to this irrigation system when it comes to spending money for initial setup, the pipes need to be clean frequently to avoid breakage. Nevertheless, with all these taken into factor, this method is being adopted in places with lower water levels.

2.3.2 DRIP IRRIGATION SYSTEM

This new method of irrigation is also widely known to people as trickle irrigation. After being developed in Israel, it rose to popularity in areas with water shortages. This system proved to be very effective for watering fruits and vegetables specifically. This method can also be put into use for regions with uneven soil conditions. The water is supplied to the fields through small nozzles in the form of water droplets, the nozzles are attached to the pipes running across the fields. The water is claimed to be saved up to seventy percent when compared to floods.

Moreover, there is no or minimal growth of weeds since the water is only supplied to the plans. Fertilizers and pesticides can also be supplied to the plants through this method via the pipelines. This reduces the rate of fertilizers consumed from sixty to approximate value of around thirty percent.

There are two ways in which this method can be installed, namely: surface and sub surface drip. Figure 2.2 illustrates the surface method which is short lived when compared to sub surface system.

Other than monitory disadvantage for initial setup, this irrigation method is not recommended for all types of crops as it may supply only limited nutrients to the crops.


Figure 2.2 – Drip Irrigation System

2.3.3 POT IRRIGATION SYSTEM

This method is considered to be the alternative to the drip method. After its origin in North Africa and Iran, it became widely used in areas with water shortage. It is also put into use with regions having low rainfall and saline soil conditions, where flow irrigation methods are proved to be unsuitable.

The installation of this method is a little tricky, initial step involve few pitchers to be fixed in the ground up to their neck. After which the pitchers are filled with water, and holes are made so the water could flow into the soil through seeping. The factors that affect this system are humidity levels, type of the soil, size of the pitcher and the amount of water seeping out from the holes in the pitcher.

The advantages of this system are mainly when it comes to its implementation which goes up to six years, the area around the Picher only gets moisture, hence decreasing the evaporation losses.

the only disadvantage is that it is not recommended for all types of crops, this method can only be put into use for horticulture vegetables and fruits. the holes made in the pitchers have to be cleaned time to time to prevent blockage.

CHAPTER 3

AUTOMATION

3.1 INSIGHT

In simple language, automation can be described as any process which reduces physical effort made by the human for the same. In automation, a machine is analogous to a human and so are all its sensory organs: feel, hear, listen, taste and see. Just like our brain, every machine has a central controlling unit where to the machine constantly sends the signals it receives. The control unit receives these input signals, processes it and sends them back as output signals to the actuator.

Automation ranges from controlling thermostat at home for a boiler, to controlling thermostats for factories. It is not limited to just that and can be expanded to areas with control systems with thousands of input and output controlling signals for measurement. Figure 3.1 shows us the analogy between human and machines. The figure gives us a detailed insight of how machines and humans can walk hand in hand.

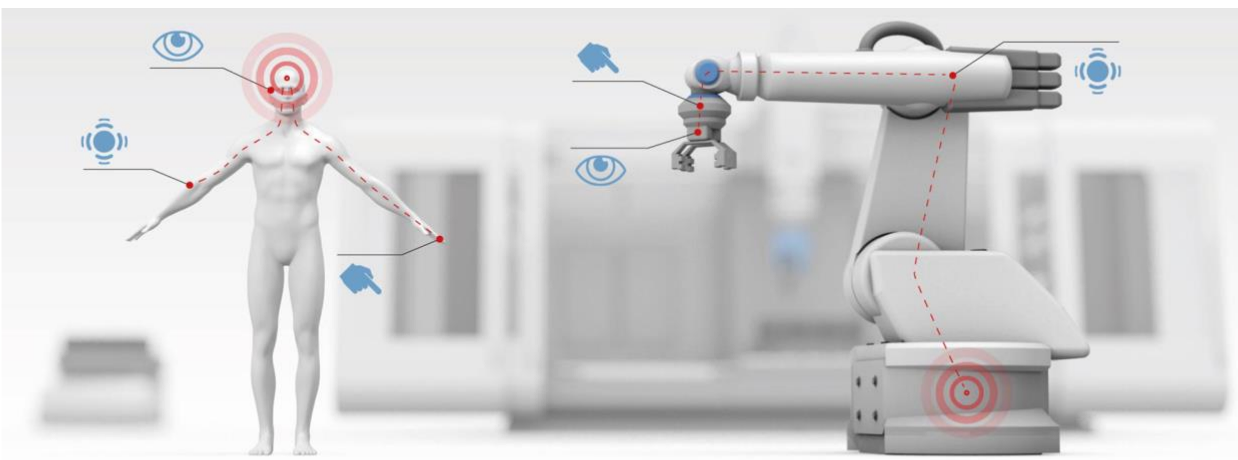


Figure 3.1 – Analogy

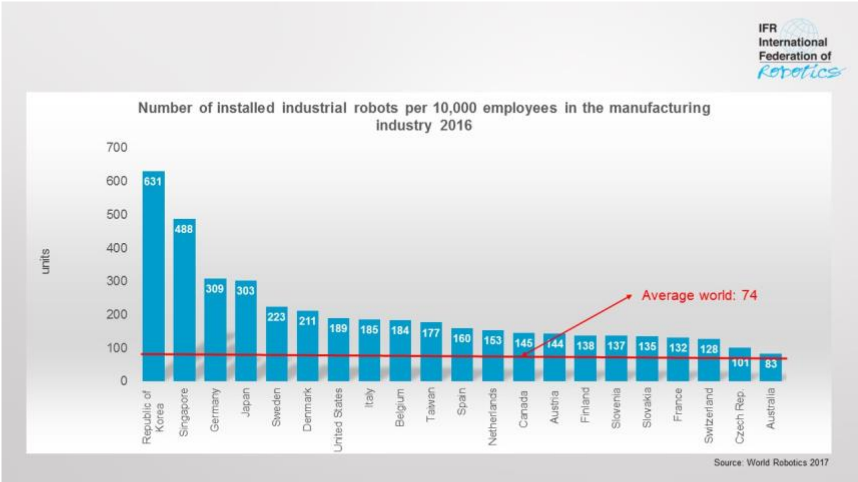
The simplest type of automatic controller loop, a control system begins with comparing an already measured set of values of a process with the desired set and providing errors in case the resulting values do not meet the expected result. This way the whole system stays on the point despite the disturbances that may or may not occur, this idea of proving a feedback is very effective in complex process with thousands of comparable parameters and small errors.

Automating processes can be achieved by different parameters including mechanics, hydraulics, pneumatics, electronic signals, electrical devices and computer operated machines, or in combinations of the same.

In the report presented to us recently by World Bank's World Development Report 2019, it has evidences showing that the worry of most people in the field sector that there would be a loss in jobs proved to be wrong, since innovation opened jobs in new creative industries. Illustrated in the Graph 3.1.

3.1.1 TYPES OF AUTOMATION TOOLS

- Artificial Neural Network (ANN)
- Distributed Control System (DCS)
- Human Machine Interface (HMI)
- Supervisory Control and Data Acquisition (SCADA)
- Programmable Logic Controller (PLC)
- Instrumentation
- Motion control
- Robotics
- Host Simulation Software (HSS)



Graph 3.1 – Industrial Robots

3.1.2 CURRENT LIMITATIONS

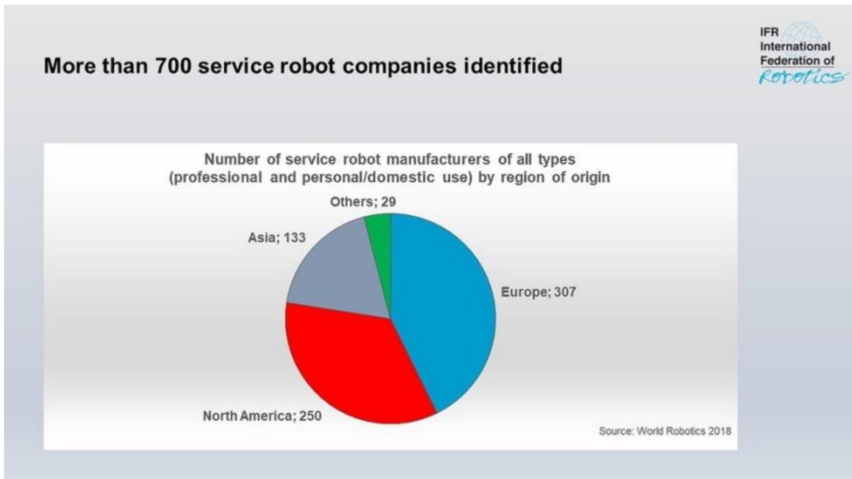
- The technology available in the market is not competent enough to automate all the desired tasks.
- Most of the operations that are required for automation require expensive machinery and initial setups. They also produce results in high volume and hence a single error can prove to be costly beyond repair. Therefore, to keep a track on machines, human physical labor is required at all times to keep a check on these errors if and when they occur.
- When processes move towards automation, there is minimal labor to be saved and improvements in results produced. This is a crucial example of both decreasing results and the logistics function.
- With more automation activities coming in the market there is minimal requirement for non-automated tasks, this results in the exhausting of opportunities. Newer technology-based paradigms have however improved upon the existing limits to surpass them in the job market.

3.1.3 ANALOGY TO HUMANS

A machine can be compared to humans in the following counter parts:

- **Sense of touch, sight, smell, taste** – Visions, pressures, photoelectricity, induction, capacitive sensors, positions/distances measurement systems
- **Hearing** – RFID reading headers, ultrasonic sound sensors
- **Nervous system** – Connecting wires, networking, cables
- **Decision making** – Controlling systems, PLCs
- **Languages** – RFID reader heads, ability for horns, smart lighting systems
- **Use of muscles** – drivers, motors, valves, horns, lights, stacks

The Graph 3.2 shows us the number of companies manufacturing robots around the world.



Graph 3.2 – Robot Manufacturers

3.1.4 DETECTING

The ways to collect, detecting the location or knowing the positions of objects in. automation are not limited to just a few, instead there are many possibilities already known to man and yet more to discover. Magnets, light and sounds can be used with proper tools to detect both metals and non-metals, solids and liquids without physical contact. This can be successfully achieved from distances ranging from 1mm all the way up to 60m.

Detection and inspection of parts become really easy and reliable during transportation with the assist of suitable sensors. Depending on the task that need to be performed, you can switch between inductive, ultrasonic sensors, or capacitive and photoelectric.

Photoelectric and ultrasonic range for greater distances(>50 mm), whereas in case of capacitive and inductive it is for closer distances (<50 mm).

Depending on the required task area we can choose from the following areas for detection:

- **Inductive sensors** for metal objects in a close range
- **Capacitive sensors** for detection the levels or presence of any metal or liquid in closer ranges.
- **Photoelectric sensors**
- **Ultrasonic sensors** for figuring objects located at greater distances

3.1.5 MEASURING

To measure distances travelled, positions and angles of objects in consideration are one of the most common tasks in the automation industry. Even though the key principle used in every task differ the possible solutions are not limited to just a few. There are many ways both effective and some ineffective when speaking in terms of money out there that can be put into use for measuring the key parameters and factors.

With photoelectricity based devices the determination of sizes and positions of the objects becomes easy during the flow rates of production line. Both surface properties and color of the object taken into consideration have no key effect on the measuring qualities.

3.1.6 IDENTIFYING

One can ensure that the right parts have arrived at the right place on the designated time slot using industry identification system in the complete automated processes. These systems when implemented properly can help in cost reduction and quality assurance.

If there is a need of unique identification an object in the production line, a data carried will be needed. This can be in the form of a barcode label, imprinted barcodes or an RFID.

When the objects containing data, carrier move through production channels, the reader located on the objects that are required to be identified could read the data out. Then the data is sent to a processing medium which converts it in the form for PCs, high ITs or PLCs. The data finally is used to make decisions about qualities and productions.
For now, there are two basic technologies available to you for identifying namely Radio frequency identification and the RFID which use radio waves and barcodes respectively to read the recorded images to analyze the data using software made for the same.

RFID

Ultra-High Frequencies (UHF), Low Frequencies (LF) or High Frequencies (HF) are most common types of RFIDs technology available to us at the moment. They usually comprise of three basic components namely, reader/writer heads for transmission, data carriers for storing data and a processing unit for data communications.

- UHF proves to be helpful when dealing with data from ranges up to 6m with multi tagging.
- With its ability to deal with high speeds the HFs enables for tracking in a closer range environment of about 400 mm. these carries comprise of properties to deal with high temperature values, large memories by attaching itself to metal
- When one has to deal with challenging conditions, the LF type is recommended for identification when dealing with metal surroundings and hence this type is most commonly used for identifying the tools.

Barcode readers

The barcode reading technology can be divided into 1D and 2D depending upon their needs. The detection ranges can go from few mm to several thousand meters.

3.1.7 CONNECTING

This can be also referred to as the spine of the whole automation industry, as connecting wires to send signals is the basic building block. Without this there would be no communication between two process, input and output flow of data etc. whenever a communication channel has to be made for any flow of data or transportation of materials over the manufacturing cycle, we need to have wires or wireless means of communications.

The whole industrial block contains various types of machines which when tuned to work in synchronization, are required to manufacture a product. In every machine block there would be a certain kind of sensor which transfers the appropriate signals to the PLCs for the working. The control panel makes use of these signals to actuate the process with suitable steps. This can be achieved in following mentioned steps:

- Each single sensor block is wired to the PLC box
- In case of multiple junctions being present all of them are wired
- The sensors are usually connected via the fieldbus blocks to the PLC

Over time the usage and what wire and cables can perform have significantly improved, in previous days the sensors were usually wired to the PLC using some sensor cable. To improve upon these existing factors and to reduce cost and efforts put in, junction blocks are used to accumulate and send multiple chains of signals via their way to the PLCs. To add to these improvements, there are ways in which non-contact signal transfers can be made possible in crucial application process.

3.1.8 I/O LINK

In simple words AI can be considered as a concept of making intelligent machines which can closely function as a human brain. In this era of IoT (Internet of Things), where we are making the smallest of the devices connected to the internet and communicate with each other via the same. With access to the Wi-Fi in every place even the remote area around the world where one could not think of the possibility of internet once, people are using the internet.

Watches used to be a dial with two hands, and over time everything has become “smart”. Be it smart watches, Apple Home or Google Home let you control the whole house not with a click but with your voice commands. If looked from a broader perspective the two things that boosted this advancement in artificial intelligence – the will to automate everything that is possible to reduce human effort and wider and cheaper availability of the internet in places that could not be imagined a decade back.

- **Universal** – IO-Linking is of international standards
- **Smart** – IO-Linking enabled parameters with diagnostics
- **Easy** – IO-Linking proves to be of greater simplification and cheaper costs over time

CHAPTER 4

SCADA

4.1 ABOUT SCADA

A SCADA (supervisory control and data acquisition) is an automated control system which is currently used in industries such as the oil and gas, hydro power etc. with potential for being used in other industries like agriculture. In simple terms a SCADA system usually automates the power system in the industries through remote control.

The system is equipped with a centralized system that controls as well as monitors the entire site, ranging from as industrial plan to a complicated plant situated across the country. The SCADA system operates by sending control signals via channels that permits the user to control any equipment through a remote while located miles away from the actual machinery. Figure 4.1 is the SCADA system installed at ICBA, Dubai.

Over time it has made progress and given its users multiple choices and device freedom from which they may control the machinery. Over the decades and with boon in technology, people have the freedom to control the system through their mobile devices which was earlier limited to only desktops and laptops connected through the LAN wire.

In simple steps the it controls the industrial processes locally or at remote locations, gathers and process real time data, directly interacts with sensors and motors on the field and finally creates a log file to record the events.

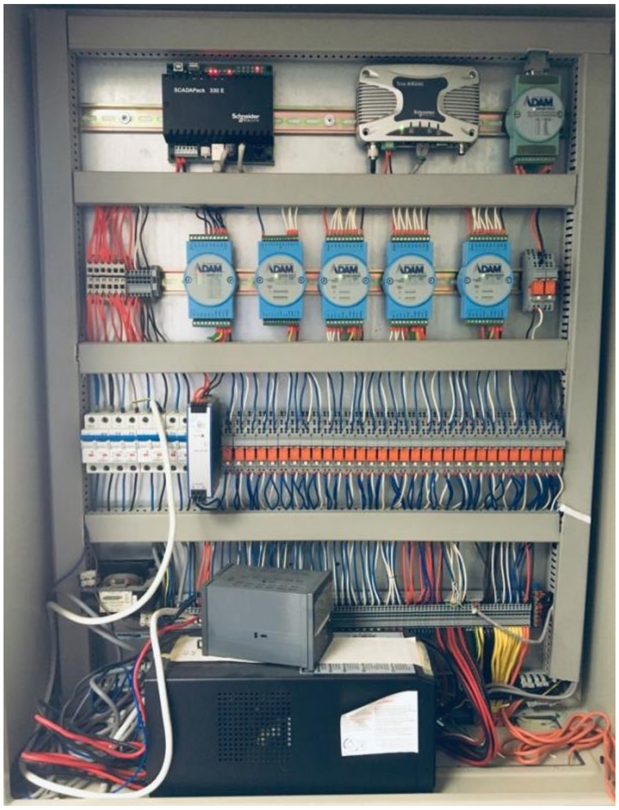


Figure 4.1 – SCADA System at ICBA

4.2 COMPONENTS OF SCADA

- ✓ Sensors
- ✓ Conversion Units
- ✓ Master Units
- ✓ Communications Networks

4.2.1 SENSORS

The SCADA system also makes use of distributed database or tag database which has point or tag that are spread across the plant in order for a consistent flow of signals and receiving the required data accurately and efficiently without any error or wrong values. These points are responsible for a consistent input or output values that is controlled and monitored by the SCADA system in centralized control room. Digital sensor can measure “discrete” input, or simple on/off signal. For example, digital sensor can inform whether a light is on or an alarm has been tripped as shown in figure 4.2.

The received or sent points are stored in the distributed database in pairs of value against the timestamp when the signal was sent across or received back in the control room. It is a very common practice these days to set up a SCADA system for acquiring metadata, such as programmable logic controller (PLC) for registering paths and alarm statistics.

Figure 4.2 – Sensor at ICBA

4.2.2 CONVERSION UNITS

The data sensors will collect the required data for you, but it would be in the raw form, so you need a convertor unit to convert it into a form that can be useful to us and can be studied upon. Figure 4.3 shows the conversion unit installed at ICBA provided by ADAM.

Figure 4.3 – Isolated Converter at ICBA

The conversion in simple words converts the raw digital signals into numerical values can be understood by us and worked upon.

RTUs, or “Remote Terminal Units,” are electric powered devices being controlled by a microprocessor.

PLCs, or “Programmable Logic Controllers,” on the other hand can be used in the place of RTUs but you will need the knowledge of programming to make the best out of it.

4.2.3 MASTER UNITS

The brain unit also knows as the master panel (figure 4.4) is the mainframe computer. This unit mainly serves as the SCADA’s central processing unit. It comprises of human based interactive software that records the data from the sensors and provides to humans.

Although this whole “unit” system in general is a larger part of the computer, other categories like the software systems and HMI can possibly come under this category.

Human Machine Interface, The HMIs is a not so complex device that gives user the freedom to watch the value fluctuations and interact with the recorded data. With advancements in technologies, they are now more user friendly when it comes to their graphical interface. The user can easily make reports, collect the necessary data for the same and provide notifications.

Figure 4.4 – Master Unit at ICBA

The human machine interface panel requests for the stored data from the data storage server, a hardware that basically connects the software services to the conversion units present in the field (PLC and RTU), therefore this process is called "data acquisition".

4.2.4 COMMUNICATION UNITS

Lastly, the system is required to connect the sensors, the conversion unit to the main master frame for communication to be possible. Methods of communicating can depend on the type of system that we need to install, but they could be put into two simple categories: with wire (telephone line, WAN circuit) and wireless means of communication (radios - Figure 4.5, cellular means, satellites).

Figure 4.5 – Campbell Radio

4.3 INDUSTRIES USING SCADA

SCADA systems find its usage in many industry sectors, be it private or public. They are useful for maximizing output and reducing input costs making the whole process more efficient and time effective. These systems can be useful in almost all types of installations including complex ones, because even if the initial setup cost is expensive, overtime the cost is paid in returns for the profits made by the company. This is the reason that with coming years the demand for SCADA installation is increasing all around the world regardless of the scale of the industry.

- Energies
- Food and beverage
- Manufacture Units
- Petrol Chemicals
- Generating Power
- Recycle Units
- Transport Sector
- Water and waste water

CHAPTER 5

DATA ACQUISITION FROM SCADA

5.1 INTERFACE AT ICBA

The interface for the SCADA system installed in the SCADA system is fairly easy to use and set the required appropriate schedules. In the previous chapter it was discussed in detail to which SCADA system is installed at ICBA and its specifications and range of tasks that can be performed. Every organization can design its layout map of their field of interest that needs to be controlled by the SCADA system. Figure 5.1 illustrates the design that was made especially for ICBA with every single sensor, water source, pipelines etc. installed in the fields.

There are two modes of function, first is the manual mode and the other one is the automatic run mode. Manual mode as the name suggests is the one in which the data for water and nutrients scheduling is fed manually into the system, after which the program is put into auto mode where the water is supplied to the fields with selected parameters on regular basis as per the schedule fed to the system.

In the figure 5.1 we can see all the water sources, the valves, the flowmeters, pressure and salinity sensors installed in the field. These can be accessed either manually on the field, or via the interface of the SCADA system in case of any malfunction or rescheduling of data. Entering data is a fairly easy task and the water valves can be controlled from the SCADA room using this system.

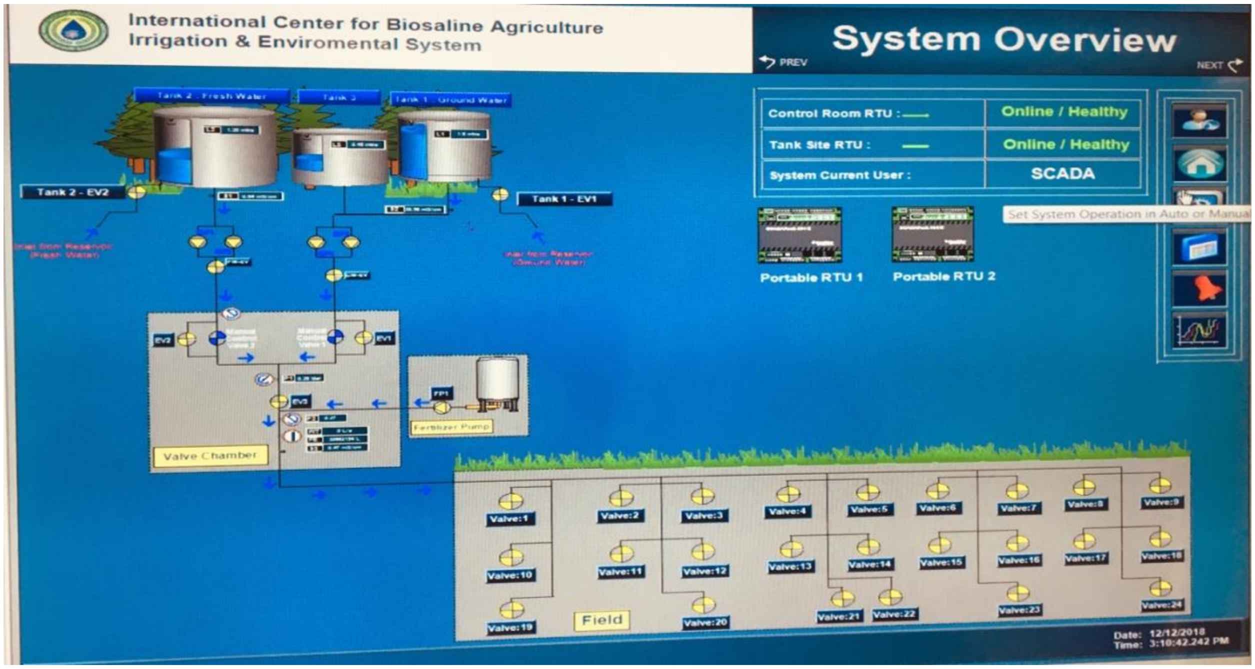


Figure 5.1 – SCADA Interface at ICBA

5.2 DATA

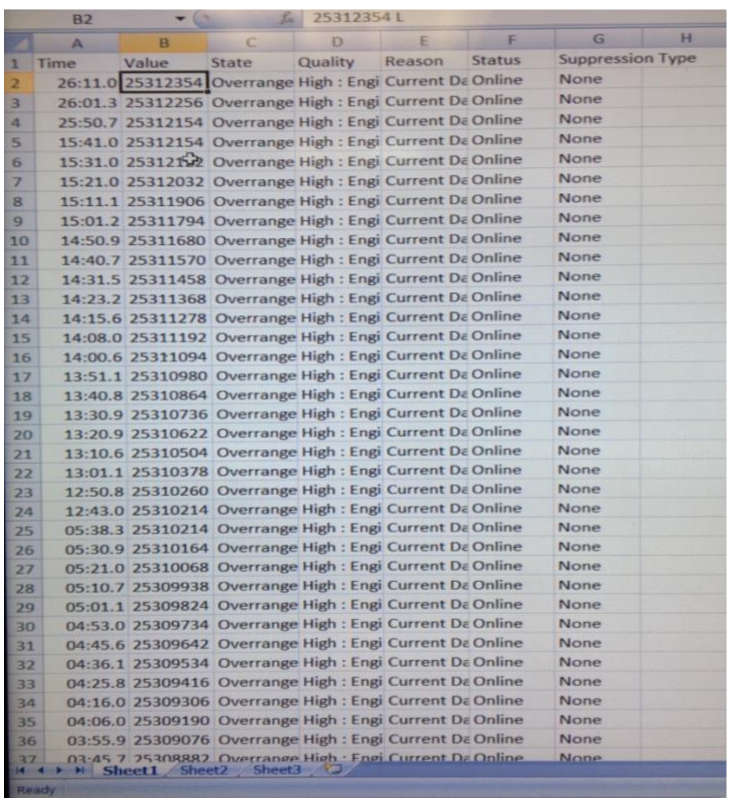
Some of the data that can be acquired by the SCADA system is listed below, but for this report we shall by only looking at the Flowmeter Data and the Salinity Data.

- ✓ Flowmeter Data from the valves
- ✓ Salinity Data
- ✓ Pressure Data
- ✓ Temperature Data

5.2.1 FLOWMETER DATA

The flowmeter data deals with the consumption of water, the total water released from the source and how much was wasted and efficiently used up the by the crops. In organizations like ICBA where it is important to keep a track of total water consumed on a hourly, daily, weekly, monthly and in some cases yearly as well, the SCADA interface proves to be of crucial importance. The irrigation is scheduled prior to the whole process as requested by the scientists for their projects, and every valve (inlet and outlet) at every stage keeps a record of the time stamp along with how much water flow was there through the valves.

The schedule is entered manually after which the system is set into auto mode and the irrigation takes place according to the data fed into the system. Figure 5.2 is the snapshot of the data that was acquired during this internship from the SCADA system about the total waterflow, it can be noticed that there is timestamp, the value of water consumed and the status of the system during the process.



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9	15:01.2	25311794	Overrange	High : Engi	Current Da	Online	None	
10	14:50.9	25311680	Overrange	High : Engi	Current Da	Online	None	
11	14:40.7	25311570	Overrange	High : Engi	Current Da	Online	None	
12	14:31.5	25311458	Overrange	High : Engi	Current Da	Online	None	
13	14:23.2	25311368	Overrange	High : Engi	Current Da	Online	None	
14	14:15.6	25311278	Overrange	High : Engi	Current Da	Online	None	
15	14:08.0	25311192	Overrange	High : Engi	Current Da	Online	None	
16	14:00.6	25311094	Overrange	High : Engi	Current Da	Online	None	
17	13:51.1	25310980	Overrange	High : Engi	Current Da	Online	None	
18	13:40.8	25310864	Overrange	High : Engi	Current Da	Online	None	
19	13:30.9	25310736	Overrange	High : Engi	Current Da	Online	None	
20	13:20.9	25310622	Overrange	High : Engi	Current Da	Online	None	
21	13:10.6	25310504	Overrange	High : Engi	Current Da	Online	None	
22	13:01.1	25310378	Overrange	High : Engi	Current Da	Online	None	
23	12:50.8	25310260	Overrange	High : Engi	Current Da	Online	None	
24	12:43.0	25310214	Overrange	High : Engi	Current Da	Online	None	
25	05:38.3	25310214	Overrange	High : Engi	Current Da	Online	None	
26	05:30.9	25310164	Overrange	High : Engi	Current Da	Online	None	
27	05:21.0	25310068	Overrange	High : Engi	Current Da	Online	None	
28	05:10.7	25309938	Overrange	High : Engi	Current Da	Online	None	
29	05:01.1	25309824	Overrange	High : Engi	Current Da	Online	None	
30	04:53.0	25309734	Overrange	High : Engi	Current Da	Online	None	
31	04:45.6	25309642	Overrange	High : Engi	Current Da	Online	None	
32	04:36.1	25309534	Overrange	High : Engi	Current Da	Online	None	
33	04:25.8	25309416	Overrange	High : Engi	Current Da	Online	None	
34	04:16.0	25309306	Overrange	High : Engi	Current Da	Online	None	
35	04:06.0	25309190	Overrange	High : Engi	Current Da	Online	None	
36	03:55.9	25309076	Overrange	High : Engi	Current Da	Online	None	
37	03:45.7	25308882	Overrange	High : Engi	Current Da	Online	None	

Sheet1 Sheet2 Sheet3

Ready

Figure 5.2 – Flowmeter Data From SCADA

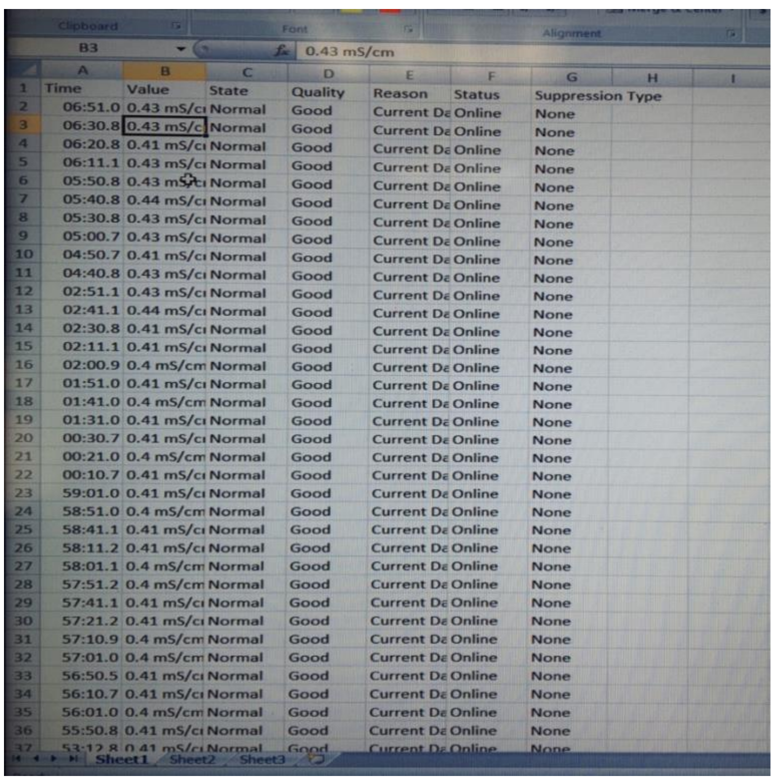
One can easily view the water trend history of any particular valve that he wishes to by simply right clicking, going to water trend history and downloading the necessary data in tabular form. the data downloaded is later studied and can be worked upon as per the crop requirement and any major changes can be altered in the next scheduling of the whole project in the SCADA system. The system keeps track of water released from the main water storage tanks, and the water let into the fields by the individual valves on a daily basis.

5.2.2 SALINITY DATA

In places near the sea, measuring salinity is an important factor when it comes to water consumption for agricultural purposes. The salinity content has to be kept constant through the project for efficient results. The SCADA interface allows the user to feed in the saline content into the water dispatched and record fluctuations throughout, if and when they occur during the project.

In ICBA, the scientists work throughout to conduct research on crops that can be cultivated in saline as well as non-saline environments, and hence it becomes a vital task to input and record the salinity data and fluctuations during this. Figure 5.3 below is the snapshot of the salinity meter data that was being recorded throughout the project from the SCADA system. The user can select the required time stamp as per his need and know the fluctuations that may have occurred.

The SCADA system allows permits the user, to mix the two water types, fresh and saline before they are released to the crops from the vales, the necessary percentage can be entered by the user and in most cases, it remains constant throughout the project for best results.



Time	Value	State	Quality	Reason	Status	Suppression Type
06:51.0	0.43 mS/c	Normal	Good	Current Da	Online	None
06:30.8	0.43 mS/c	Normal	Good	Current Da	Online	None
06:20.8	0.41 mS/c	Normal	Good	Current Da	Online	None
06:11.1	0.43 mS/c	Normal	Good	Current Da	Online	None
05:50.8	0.43 mS/c	Normal	Good	Current Da	Online	None
05:40.8	0.44 mS/c	Normal	Good	Current Da	Online	None
05:30.8	0.43 mS/c	Normal	Good	Current Da	Online	None
05:00.7	0.43 mS/c	Normal	Good	Current Da	Online	None
04:50.7	0.41 mS/c	Normal	Good	Current Da	Online	None
04:40.8	0.43 mS/c	Normal	Good	Current Da	Online	None
02:51.1	0.43 mS/c	Normal	Good	Current Da	Online	None
02:41.1	0.44 mS/c	Normal	Good	Current Da	Online	None
02:30.8	0.41 mS/c	Normal	Good	Current Da	Online	None
02:11.1	0.41 mS/c	Normal	Good	Current Da	Online	None
02:00.9	0.4 mS/cm	Normal	Good	Current Da	Online	None
01:51.0	0.41 mS/c	Normal	Good	Current Da	Online	None
01:41.0	0.4 mS/cm	Normal	Good	Current Da	Online	None
01:31.0	0.41 mS/c	Normal	Good	Current Da	Online	None
00:30.7	0.41 mS/c	Normal	Good	Current Da	Online	None
00:21.0	0.4 mS/cm	Normal	Good	Current Da	Online	None
00:10.7	0.41 mS/c	Normal	Good	Current Da	Online	None
59:01.0	0.41 mS/c	Normal	Good	Current Da	Online	None
58:51.0	0.4 mS/cm	Normal	Good	Current Da	Online	None
58:41.1	0.41 mS/c	Normal	Good	Current Da	Online	None
58:11.2	0.41 mS/c	Normal	Good	Current Da	Online	None
58:01.1	0.4 mS/cm	Normal	Good	Current Da	Online	None
57:51.2	0.4 mS/cm	Normal	Good	Current Da	Online	None
57:41.1	0.41 mS/c	Normal	Good	Current Da	Online	None
57:21.2	0.41 mS/c	Normal	Good	Current Da	Online	None
57:10.9	0.4 mS/cm	Normal	Good	Current Da	Online	None
57:01.0	0.4 mS/cm	Normal	Good	Current Da	Online	None
56:50.5	0.41 mS/c	Normal	Good	Current Da	Online	None
56:10.7	0.41 mS/c	Normal	Good	Current Da	Online	None
56:01.0	0.4 mS/cm	Normal	Good	Current Da	Online	None
55:50.8	0.41 mS/c	Normal	Good	Current Da	Online	None
53:12.8	0.41 mS/c	Normal	Good	Current Da	Online	None

Figure 5.3 – Salinity Data From SCADA

CHAPTER 6

CROP CALCULATOR PROJECT

6.1 DESCRIPTION

The crop calculator project is being conducted in ICBA in collaboration with EAD (Environment Agency – Abu Dhabi). The aim of this project is to grow three crops in controlled environment and water conditions. The crops that have been chosen to conduct experiment upon are: tomato, capsicum and cucumber. The seeds for the three crops have been sown in two areas at ICBA, the greenhouse as shown in Figure 6.1 and the shade house shown in Figure 6.2. The crops are being grown in monitored water supply - Fresh water, RO Fresh and Nano Fresh water.

In simple steps the it controls the industrial processes locally or at remote locations, gathers and process real time data, directly interacts with sensors and motors on the field and finally creates a log file to record the events.

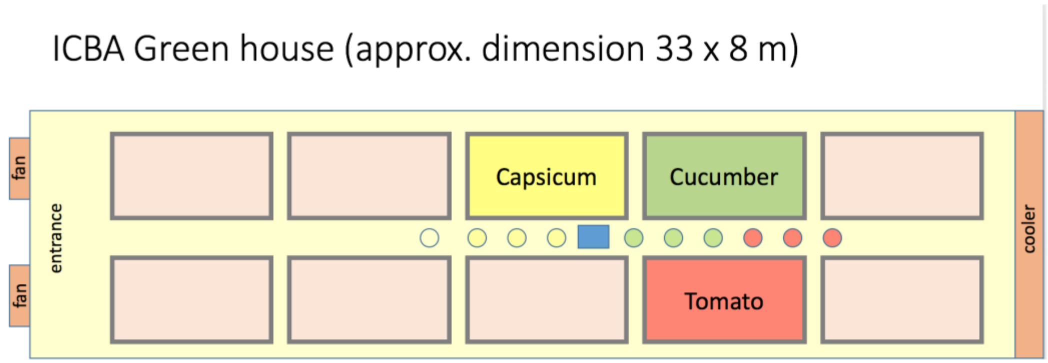


Figure 6.1 – Greenhouse at ICBA

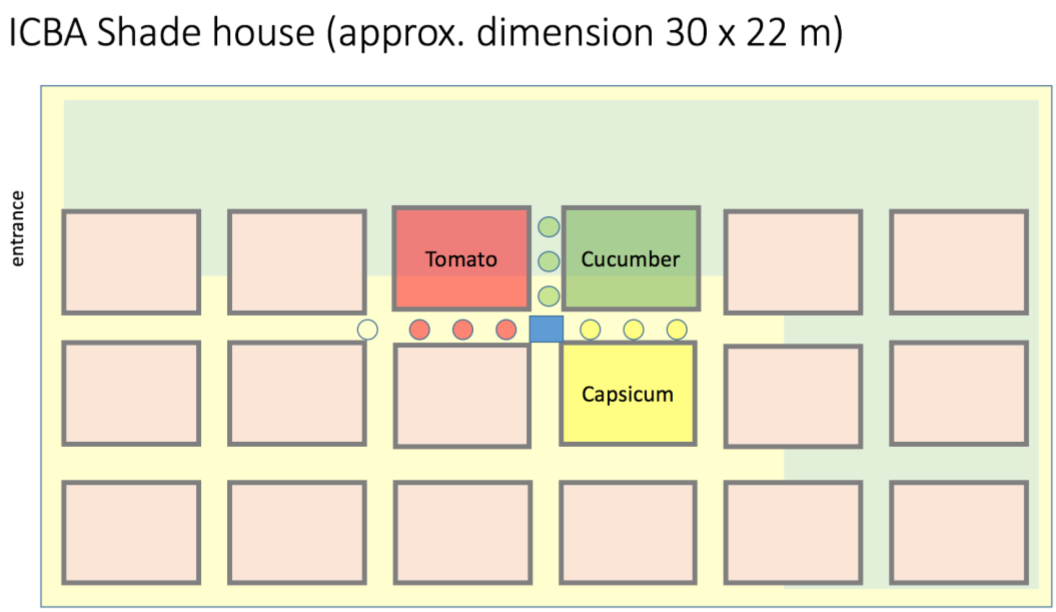


Figure 6.2 – Shade House at ICBA

6.2 TASKS TO BE PERFORMED

- ✓ Preparation
- ✓ Maintenance
- ✓ Harvesting

6.2.1 PREPARATION

The following table, Table 6.1 were the tasks that had to be performed in order to get the experiment operational by end of October 2018.

Activity	Description	Equipment required	Due Date
Soil/Compost	Fill Lysimeter pots to a level of 20cm with soil and compost, mixed 1-part compost to 2 parts soil. No stones in the soil.	Soil and Compost	Monday 1st October
Irrigation	Supply and run irrigation tubing in both net house and green house. Install pressure compensated drippers (supplied by NZ team)	Irrigation Tubing and controller	Tuesday 2nd October
Fertiliser	Determine and install the fertiliser system to fertigate the crops in both net house and green house	Fertigation system	Tuesday 2nd October
Plants	Source seedlings to plant or begin growing from seed.	80 x Tomato, 80 x Capsicum, 80 x Cucumber	Determine source or begin growing by Thursday 4th October
Training	Identify key person in ICBA to be the contact that EAD and NZ team can work with to manage and monitor the experiments. - Steve Green to train EAD and ICBA staff on Thursday – overview of the experiment and downloading of data - Photos to be taken every 2 weeks of the crops, from the same spot with the same camera		Thursday 4th October
Planting	Determine how to string up the crops in the net and greenhouses. Please refer to planting plan at the end of this document		Before Planting

Table 6.1 - Preparation

6.2.2 MAINTENANCE

The Table 6.2 gives the description about the procedures required to be undertaken weekly during the experiment.

Activity	Description	Responsibility
Data	Download the data loggers and send to PFR Phots to be taken every 2 weeks of the crops, from the same spot with the same camera. These are to be labelled and sent to Steve Green	EAD
Water Samples	Every Sunday insert catch can under tipping spoon to collect water sample. - Water sample to be collected and placed in sample jar every Monday - Sample jar to be labelled with Lysimeter number and date (month/day) - Place samples in freezer	ICBA
Irrigation	Apply irrigation according to agreed schedule and ensure that it is switched off at the appropriate time	ICBA
Irrigation	Ensure sufficient water in tanks for irrigation	ICBA
Fertiliser	Apply fertigation according to agreed schedule	ICBA
Solar panel	Clean all solar panels	ICBA
Rain Gauge	Check rain gauge to ensure it is working	ICBA
Radiometer	Clean radiometer	ICBA
Drippers	Check all dripper collection systems to ensure they aren’t blocked with sand	EAD

Table 6.2 - Maintenance

6.2.3 HARVESTING

Table 6.3 gives us the details about the harvesting phase after the whole experiment has been successfully performed.

Activity	Description	Responsibility
Produce weight	When produce is mature, produce should be harvested and both fresh weight and dry weight measured and recorded.	ICBA

Table 6.3 - Harvesting

The human machine interface panel requests for the stored data from the data storage server, a hardware that basically connects the software services to the conversion units present in the field (PLC and RTU), therefore this process is called “data acquisition”.

6.2.4 READINGS

The following data was collected from the various flowmeters situated in Greenhouse and the Shade House respectively. The figure 6.3 also contains the readings from the main inlet pipe flowmeter and the outlet flowmeter reading for the Greenhouse. Given below also are the readings recorded diurnally for the period at 12:30pm for shade house.

		Time of Observation : 2:30 pm							
		Inlet	Outlet	Green House			Shade House		
		FM-1 m^3	**FM-2**	**FM-3**	**FM-4**	**FM-5**	**FM-6**	**FM-7**	**FM-8**
Tuesday	13-Nov	173.936	752	0.99	0.665	0.689	1.331	1.452	1.436
Wednesday	14-Nov	175.966	770	0.998	0.672	0.696	1.355	1.456	1.461
Thursday	15-Nov	178.301	787	1.006	0.634	0.703	1.379	1.481	1.486
Friday	16-Nov								
Saturday	17-Nov								
Sunday	18-Nov								
Monday	19-Nov	187.619	858	1.038	0.67	0.735	1.482	1.604	1.581
Tuesday	20-Nov	189.337	875	1.045	0.678	0.745	1.506	1.624	1.604
Wednesday	21-Nov	190.921	887	1.053	0.685	0.754	1.53	1.645	1.627
Thursday	22-Nov	192.585	902	1.063	0.697	0.768	1.554	1.666	1.65
Friday	23-Nov								
Saturday	24-Nov								
Sunday	25-Nov	199.589	955	1.084	0.725	0.794	1.625	1.725	1.714
Monday	26-Nov	201.982	969	1.091	0.733	0.804	1.639	1.737	1.727
Tuesday	27-Nov	202.644	984	1.098	0.752	0.813	1.651	1.749	1.74
Wednesday	28-Nov	204.46	998	1.105	0.763	0.822	1.664	1.761	1.753
Thursday	29-Nov	205.987	1012	1.112	0.777	0.832	1.677	1.773	1.766
Friday	30-Nov								
Saturday	1-Dec								
Sunday	2-Dec								
Monday	3-Dec								
Tuesday	4-Dec	215.41	1086	1.141	0.88	0.875	1.818	1.894	1.911
Wednesday	5-Dec	217.33	1099	1.148	0.885	0.89	1.848	1.926	1.932
Thursday	6-Dec	219.108	1114	1.153	0.908	0.896	1.869	1.942	1.957
Friday	7-Dec								
Saturday	8-Dec								
Sunday	9-Dec	224.613	1155	1.176	0.929	0.929	1.968	2.368	2.014
Monday	10-Dec	227.431	1179	1.186	0.922	0.933	1.964	2.125	2.035
Tuesday	11-Dec	229.369	1195	1.193	0.934	0.943	1.988	2.152	2.057
Wednesday	12-Dec	231.306	1211	1.200	0.945	0.952	2.011	2.178	2.079
Thursday	13-Dec	233.243	1226	1.207	0.957	0.961	2.035	2.204	2.101
Friday	14-Dec								
Saturday	15-Dec								
Sunday	16-Dec	239.055	1273	1.229	0.991	0.989	2.105	2.283	2.167
Monday	17-Dec	240.992	1288	1.236	1.002	0.998	2.128	2.309	2.189
Tuesday	18-Dec	242.929	1304	1.243	1.014	1.008	2.151	2.335	2.211
Wednesday	19-Dec	244.866	1319	1.250	1.025	1.017	2.175	2.362	2.233
Thursday	20-Dec	246.804	1335	1.257	1.037	1.026	2.198	2.388	2.255
Friday	21-Dec								
Saturday	22-Dec								

Figure 6.3 – FM Readings

6.3 KEYS

The key pointer references for understanding the various water type through each flowmeter is discussed in this section. The table 6.4 describes in detail as to which water type was supplied to the crops, tomato, cucumber and capsicums respectively. The water type for the crops grown in the Greenhouse are : RO Fresh, Nano Fresh and Fresh for Tomato, Cucumber and Capsicum respectively.

<table>
<tr><td colspan="6">Key for references</td></tr>
<tr><td>FM-1</td><td colspan="4">Tank Inlet</td><td rowspan="5">Green House</td></tr>
<tr><td>FM-2</td><td colspan="4">Tank Outlet</td></tr>
<tr><td>FM-3</td><td>R1</td><td>Tomato</td><td rowspan="3">13 Drippers Each</td><td>RO-Fresh</td></tr>
<tr><td>FM-4</td><td>R2</td><td>Cucumber</td><td>Nano-Fresh</td></tr>
<tr><td>FM-5</td><td>R3</td><td>Capsicum</td><td>Fresh</td></tr>
<tr><td>FM-6</td><td>R1</td><td>Tomato</td><td rowspan="3">28+3 Drippers Each</td><td></td><td rowspan="3">Shade House</td></tr>
<tr><td>FM-7</td><td>R2</td><td>Cucumber</td><td></td></tr>
<tr><td>FM-8</td><td>R3</td><td>Capsicum</td><td></td></tr>
</table>

Table 6.4 - Keys

CHAPTER 7

CONCLUSION AND FUTURE SCOPE

7.1 CONCLUSION

This report contains the data about the internship program that was undertaken at ICBA, Dubai. under BITS Pilani, Dubai Campus. The background information about this organization and its major areas of projects were also taken into consideration while making this report.

This project report deals with the irrigation system developments over decades and how technology has made major changes in that field. Two major projects were performed during the course of this internship. Also described in detail in this report are the steps taken to acquire data from the SCADA system after it has been implemented in an organization for automation of the existing irrigation systems.

7.2 FUTURE SCOPE

The project report has the necessary details and information about the mentioned objectives that need to be looked in while deciding to automate an existing process. The report gives a detail insight into factors and major circumstances that needs to be dealt with while automating any process, in this report it was the irrigation systems.

Various parameters have to be considered during the whole process and a detailed knowledge was supplied during the whole internship. The recorded data can be downloaded with the timestamps and worked upon as per the project requirements in the future.

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