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COURSE: STRUCTURED COMPUTER PROGRAMMIG

COURSE CODE: ENG224

SOFTWARE DEVELOPMENT PROCESSES

In developing an application, there are various steps that are to be taken. They are to be implemented and broadened in developing a software application, these steps include:

1. Conceptualization
2. Specification
3. Design
4. Implementation
5. Testing and Debugging
6. Release and Update

CONCEPTUALIZATION

Software conceptualization provides the basis for your project. All applications evolve from ideas in the minds of designers and programmers to become a reality as we go through the design process, adhering to project milestones and conducting our quality assurance tests all along the way.

Here, Afe babalola University Farm has a defective irrigation system, a pass worded automated machine with a system is that allows for the machine to read soil temperature, determine moisture content of the soil, configure the time interval for the water system and a triggered with an alarm if there is insufficient.

So I this design, the objectives are;

a) To design and develop an automatic irrigation system controlled by using Microcontroller.
b) To implement the automatic watering system based on soil moisture sensor.
c) To provide a system that help the plant grow with the least of manual monitoring

SPECIFICATION

A **software requirements specification** (SRS) is a detailed description of a software system to be developed with its functional and non-functional requirements. The SRS is developed based the agreement between customer and contractors, which deals with the relationship between software and hardware components. In this case;

SOFTWARE SPECIFICATION/ FEATURES

1. **Sprinkler**

An irrigation sprinkler (also known as a water sprinkler or simply a sprinkler) is a device used to irrigate agricultural crops, lawns, landscapes, golf courses, and other areas. They are also used for cooling and for the control of airborne dust. Sprinkler irrigation is the method of applying

water in a controlled manner in way similar to rainfall. The water is distributed through a network that may consist of pumps, valves, pipes, and sprinklers.

Irrigation sprinklers can be used for residential, industrial, and agricultural usage. It is useful on uneven land where sufficient water is not available as well as on sandy soil. The perpendicular pipes, having rotating nozzles on top, are joined to the main pipeline at regular intervals. When water is pressurized through the main pipe it escapes from the rotating nozzles. It gets sprinkled on the crop. In sprinkler or overhead irrigation, water is piped to one more central locations within the field and distributed by overhead high pressure sprinklers or guns.

2. Sensor

SOIL MOISTURE SENSOR

Irrigation is the most important cultural practice and most labor intensive task in planting operation. Knowing when and how much to water is two important aspects of irrigation. To do this automatically, sensors and methods are available to determine when plants may need water. It is suggested to use soil moisture sensor to do irrigation. The moisture sensor will be an important element for this project.

Most soil moisture sensors are designed to estimate soil volumetric water content based on the dielectric constant (soil bulk permittivity) of the soil. The dielectric constant can be thought of as the soil's ability to transmit electricity. The dielectric constant of soil increases as the water content of the soil increases. This response is due to the fact that the dielectric constant of water is much larger than the other soil components, including air. Thus, measurement of the dielectric constant gives a predictable estimation of water content

TEMPERATURE SENOR

A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes. There are many different types of temperature sensors. Some temperature sensors require direct contact with the physical object that is being monitored (contact temperature sensor) while others indirectly measure the temperature of an object (non-contact temperature sensors).

In this case, a contact sensor is used as it would be in direct contact with the soil. It would make known when the soil temperature is getting to high at would alert the farmer.

3. Water System/Water Pump

This is a water supply system, could either be a river or a large source of water. The pump is basically used to store water and would continuously store water, and would kick in when the water source starts to dry up (e.g.; in the dry season)

4. Solenoid Valve

Solenoid valves are electromechanical valves that are controlled by stopping or running an electrical current through a solenoid, in order to change the state of the valve. A solenoid is a

coil of wire that is magnetized when electricity runs through it. The solenoid valve makes use of this solenoid in order to activate a valve thus controlling the water flow, airflow and other things with electricity. There are three types of solenoid valves which are general-purpose type, low pressure steam type and high pressure steam pipe. Valve is one of the components that need maintenance. The solenoid valve can get damaged after some period. Thus, a replacement of solenoid valve may be needed.

5. A/D interface

Since computer systems work internally with numbers (digits), the electrical signals resulting from the sensors must be converted to digital data (see Figure 8). This is done through specialized hardware referred to as the Analog-to-Digital (A/D) interface. Discrete signals resulting from switch closures and threshold measurements are converted to 0 and 1. Continuous electrical (analog) signals produced by the sensors signals are converted to a number related to the level of the sensed variable. The accuracy of the conversion is affected by the resolution of the conversion equipment. In general, the higher the resolution the better the accuracy. For, example if a pressure sensor produces a voltage signal ranging from 0 to 5 volts for a range of pressure of 10 atmospheres, an 8 bit resolution A/D board will be able to detect a change in voltage of about 5/255 volts which will results in measurable increments of 10/255 atmospheres. If the resolution of the A/D board was 12 bit, the board would be able to detect a change in voltage of about 5/4095 volts or a measurable increment of 10/4095 atmospheres.

6. Microcontroller

A microcontroller also known as MCU and µC is a functional computer system on a chip [26]. Microcontroller is integrated chip that performs controlling function. It also referred as one-chip microcomputer is used to control a wide range of electrical and mechanical appliances [29-31]. Since they were first introduced, microcontrollers have evolved to the point where they can use for increasing complex applications. Some microcontrollers in use today are programmable, expanding the number of application in which they can be used.

7. Computer system

The A/D conversion hardware is directly connected to the computer system. Given the current state of technology, the computer system may be a PC (personal computer), a minicomputer, or a specially designed machine that is solely dedicated to the control task. The type of machine depends on the type of application, and is greatly affected by factors such as environment characteristics, complexity of the controlled system, and the speed with which conversions need to take place (controlling a high speed extruder requires much more speed than a golf-course irrigation system).

8. LED Lights

Light Emitting Diode is the full meaning of LED. In this case the LED is used to notify the framer of any changes. Basically it is what collects the signals from any of the sensors, and alerts the farmer by flashing lights.

9. **Sound System**

This would come in form of an outdoor speaker. This would act based on the signals received from the LED lights as well and would ring with the simultaneous flashing of the lights

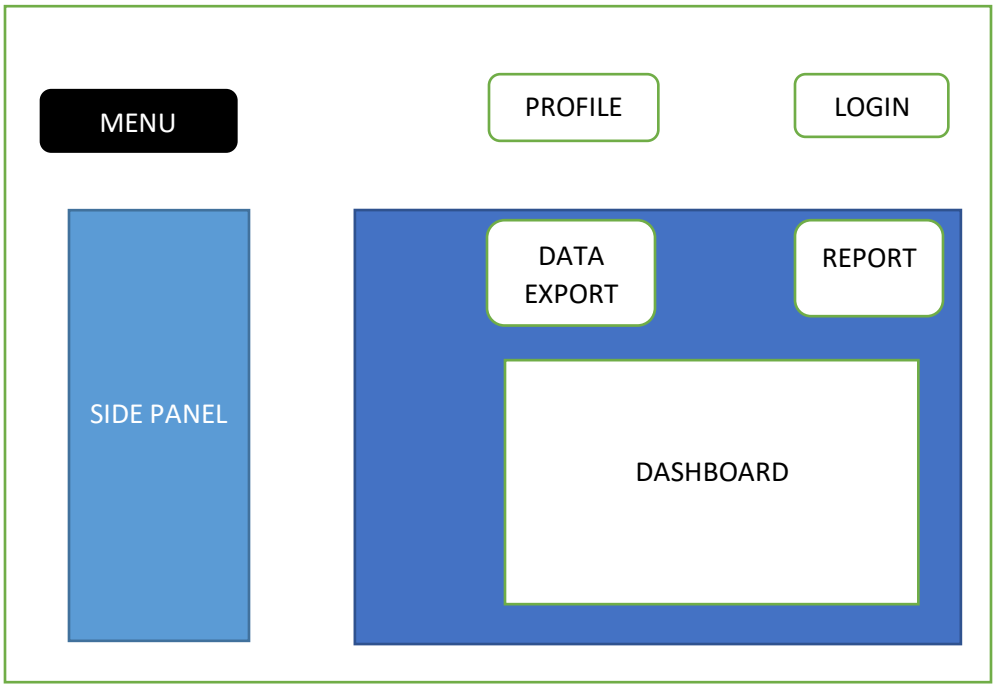
10. **Power Supply**

This would consist of a step down transformer which would reduce the high incoming high voltage, to one that can be used. It is also used to supply power for the whole system.

FUNCTIONAL REQUIREMENTS/ SOFTWARE FEATURES

1. **Control Interface/Graphic User Interphase**

Using control software, decisions may be made to modify the controlled system. The actual changes are achieved by having devices within the system that will affect the controlled variables. These devices are controlled through actuators that respond to signals from the control interface. The devices may be of the nearly continuous or discrete types.
This is basically to allow for relationship between the farmer and the system. Hence a graphical user interphase can easily designed



2. Timer

Irrigation timers are simple controllers consisting of clock units capable of activating one or more subunits of the irrigation system at specified times. Several designs are commercially available with many different features and over a wide range of costs.

In this situation, a pump start lead is used.
• Pump start lead. This feature allows a pump start solenoid to be activated whenever a station is activated, thus tying pump control with irrigation control.

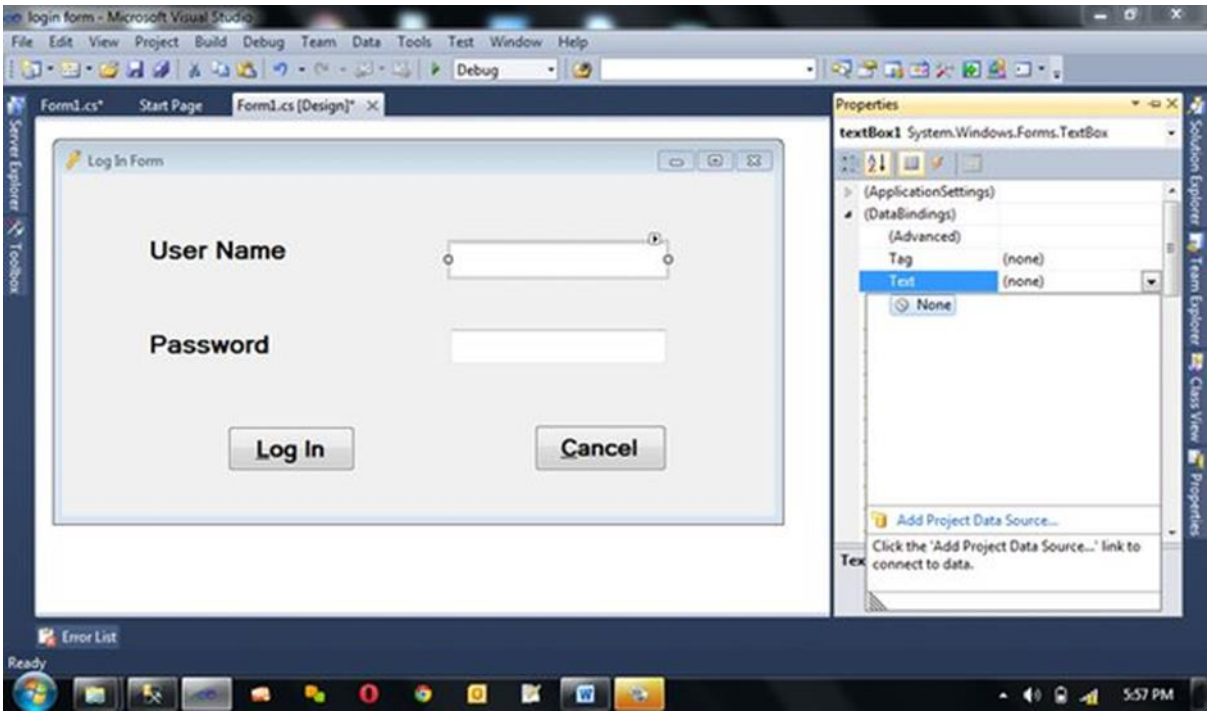
3. Access Control/ Security

The system shall protect the data and services from unauthorized access. The System shall also provide authentication and secure transaction. System should provide highest possible security mechanism in order to protect critical information. System should run privately over public network (For this Secured tunneling mechanism should be used). System should restrict all the non-member of the project to get access to the system. The system shall provide a mechanism of user authentication to unambiguously Identify a user.

Here the security used would be a pass worded system, the computer in charge of running the system would be pass worded to avoid unauthorized access. This can easily be designed or inputted by a software.
To also monitor the people who have access alongside with their data they're inputting, it is best they each have access individually through a portal.

This dashboard can be created using software such as

1. Visual basic
2. Java script
3. C+ ETC.



4. **Error Detection**

This is a means of control to check if the input into the system is still right or to detect, what is inputted into the system is up to date or needs change due to season.

DESIGN

Software design is the process of envisioning and defining **software** solutions to one or more sets of problems. Software design is divided into;

- Algorithm
- Flowchart

In this process, the process starts off with the farmer/ user logging into the user interphase with a security password, if correct it gives access if not it redirects back to the user login page and

displays input correct password. If the password is correct, a page displaying the moisture level and temperature of the soil is displayed. The user can now set a specific time range for the solenoid valves to be opened and the sprinklers allow water to flow (6:00 am -8:00 am) and (6:00 pm- 8:00pm) , the soil moisture level and soil temperature are now read using the soil moisture sensor and temperature sensor. During the time the solenoid valves are open, the soil moisture and temperature would be read. If the soil moisture has risen past 18%, the sound system is automatically turned on with the LED lights and close half of the valve that lets water go to the sprinklers, else the valves are all open then read the temperature. If temperature of the soil is measured and the sound system and lights remain off. If above 75F, the sound system is automatically turned on with the LED lights and the remaining half of the valves are closed, else they are left open and the sound system and LED lights remain off.
During the time the solenoid valves and sprinklers are closed, the soil is read, if the soil moisture is below 10%, the sound system is turned on and the LED lights begin to flash then the half of the valves automatically open and the sprinklers release water, else the valves and sprinklers remain shut and the lights remain off, then the temperature is read. If the temperature is above 75%

This cycle continues for every time within the set time (that the sprinklers should be turned on) and the soil is continually read.

ALGORITHM AND FLOWCHART

Within the time 6:00am-8:00am and 6:00pm-8:00pm

1.0. START

2.0. WATER PUMP ON

3.0. SELONOID VALVE/SPRINKLER OPEN

4.0. MOISTURE SENSOR ON

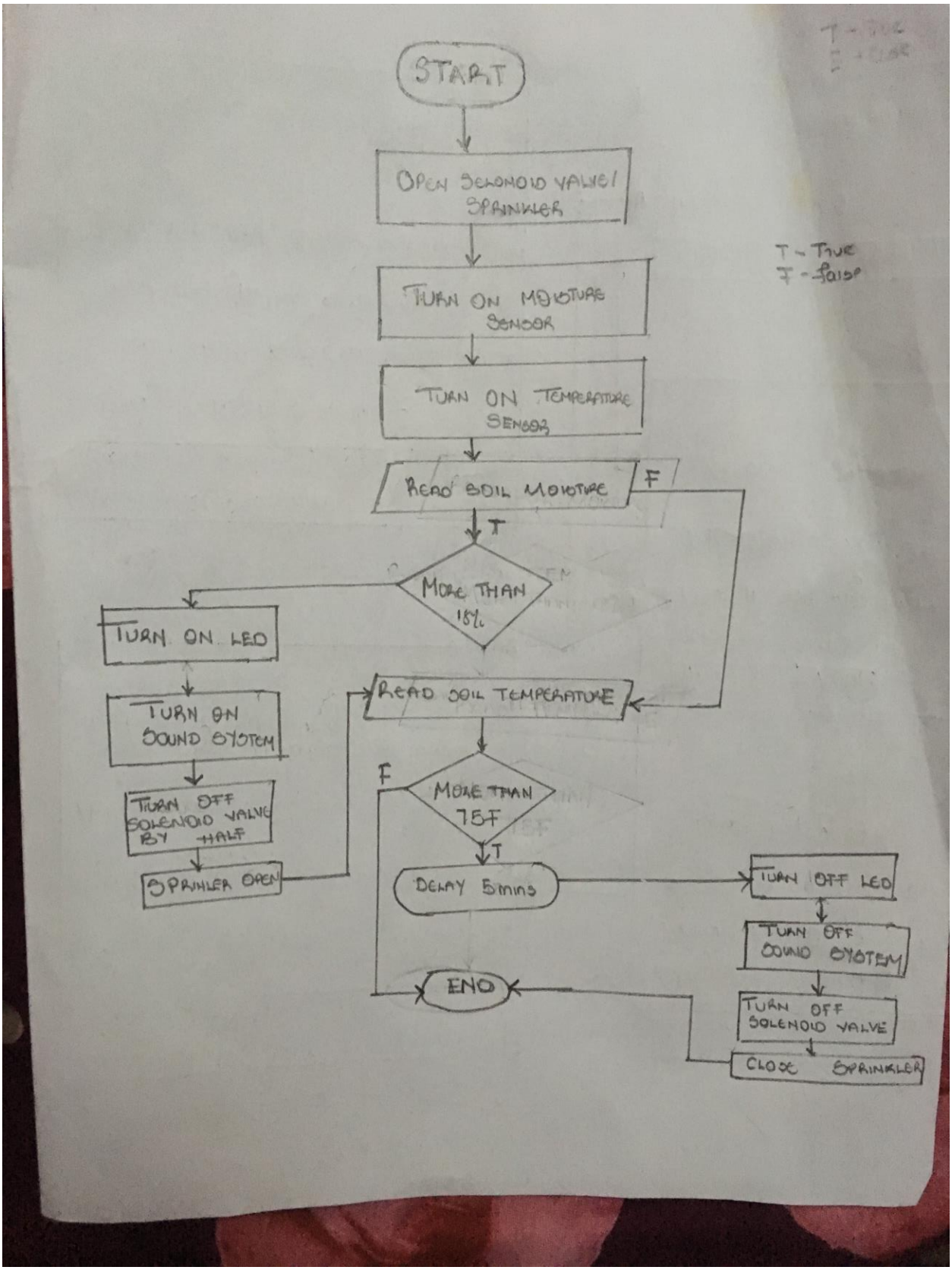
5.0. TEMPERATURE SENSOR ON

6.0. READ SOIL MOISTURE
SOIL MOISTURE== SM
IF SM > 18%
LED LIGHT ON
SOUND SYSTEM ON
SELONOID VALVE = ½
SPRINKLER ON
ELSE IF
READ TEMPERATURE

7.0. READ TEMPERATURE
TEMPERATURE==T

IF T> 75F
DELAY = 5 MINS
LED LIGHTS OFF
SOUND SYSTEM OFF
SELONOID VALVE =0
SPRINKLER OFF
ELSE IF
END

8.0. END


START
OPEN SOLENOID VALVE/ SPRINKLER
TURN ON MOISTURE SENSOR
TURN ON TEMPERATURE SENSOR
READ SOIL MOISTURE
F
T
MORE THAN 15%
TURN ON LED
TURN ON SOUND SYSTEM
TURN OFF SOLENOID VALVE BY HALF
SPRINKLER OPEN
READ SOIL TEMPERATURE
F
MORE THAN 75F
T
DELAY 5mins
TURN OFF LED
TURN OFF SOUND SYSTEM
TURN OFF SOLENOID VALVE
CLOSE SPRINKLER
END
T - True
F - false

For any other time

1.0. START

2.0. WATER PUMP OFF

3.0. SELONOID VALVE/SPRINKLER CLOSE

4.0. MOISTURE SENSOR ON

5.0. TEMPERATURE SENSOR ON

6.0. READ SOIL MOISTURE
SOIL MOISTURE==SM
IF SM<10%
LED LIGHT ON
TURN ON WATER PUMP
SOUND SYSTEM ON
SELONOID VALVE= ½
SPRINKLER ON
ELSE IF
READ TEMPERATURE

7.0. READ TEMPERATURE
TEMPERATURE==T
IF T<65F
DEALAY= 5 MIN
LED LIGHTS OFF
SOUND SYSTEM OFF
SELONOID VALVE =1
SPRINKLER ON
ELSE IF
END

8.0. END

IMPLEMENTATION

Implementation is the part of the process where **software** engineers actually program the code for the project.

The system is based on a simple feedback control loop with leachate detection as the control parameter. A Watering cycle begins when the microcomputer opens a solenoid valve pressurizing the irrigation line. Water is delivered to a container plant through the drip-irrigation equipment until leachate from the plant is detected by the moisture sensor. When leachate is detected, the solenoid valve is closed. At this point the container is assumed to be slightly above field capacity. If the plant and container are considered as a single system, the relationship between the amount of water applied and plant water demand can be determined by balancing water inputs and losses for the plant/container. If the container is covered to limit rain-fall, water into the plant/container is simply the amount of irrigation applied, while water losses from the sys-tem are due to soil/media evaporation, plant transpiration, and leaching. One can assume that the delay between the time for the container to reach field capacity and leachate detection for each irrigation cycle are similar, i.e., there is a “standard” amount of leachate at the end of each cycle. Under this assumption, the total amount of water applied at the end of any irrigation cycle will be an approximation of the evapotranspiration rate for that plant container system since the previous irrigation period less the standard leachate amount. Therefore, this control scheme applies irrigation based on the actual environmental and plant demands that drive the rate of water loss from the system since the previous irrigation. The control loop is scaled-up to a large block of containers by monitoring a few indicator plants randomly located within the block

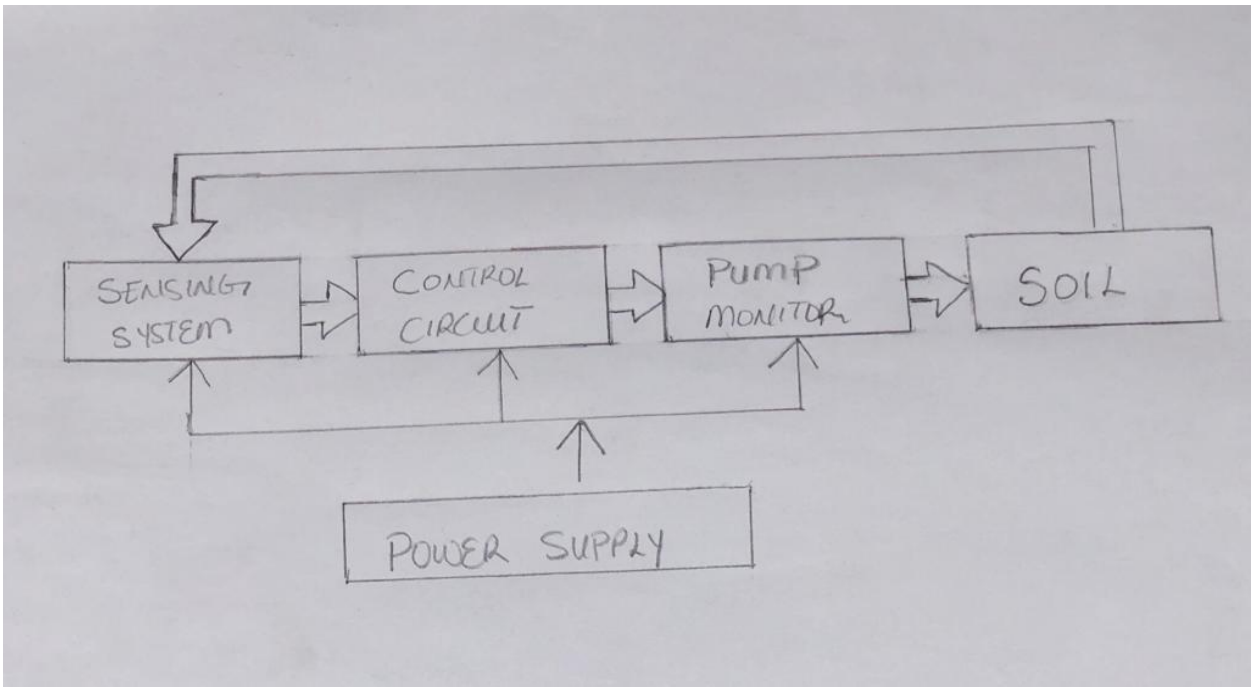
TESTING AND DEBUGGING

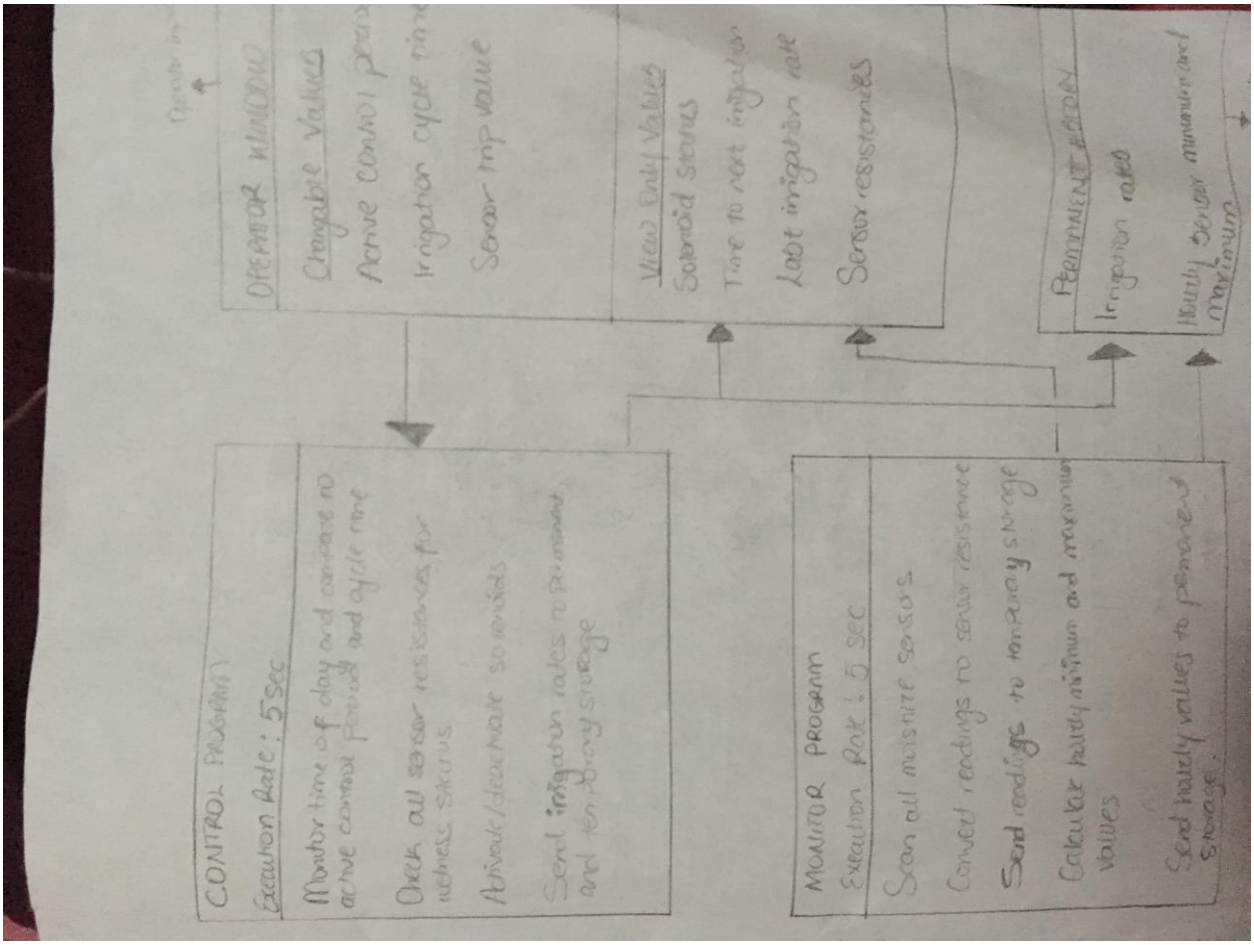
Testing has to do with running or applying the program to see if it works, Debugging is testing for syntax and logic errors for bugs in the program and then removed. This would be done by more than one person to check for correctness by using the error detection in the software.

RELASE AND UPDATE

The web based software application is then released, and alongside with the questioners for the farmers in charge of ABUAD farm there would be questions for users on what they’d like to improve. It would be sent as a feedback and if proven right, recognised as an update.

APPROACH ON THE SYSTEM


SENSING SYSTEM
CONTROL CIRCUIT
PUMP MONITOR
SOIL
POWER SUPPLY


OPERATOR WINDOW
Changable Values
Active control period
Irrigation cycle time
Sensor trip value
View Only Values
Solenoid Status
Time to next irrigation
Last irrigation rate
Sensor resistances
PERMANENT HISTORY
Irrigation rates
Hourly Sensor minimum and maximum
CONTROL PROGRAM
Execution Rate : 5sec
Monitor time of day and compare to active control period and cycle time
Check all sensor resistances for redness status
Activate/deactivate solenoids
Send irrigation rates to permanent and temporary storage
MONITOR PROGRAM
Execution Rate : 5 SEC
Scan all moisture sensors
Convert readings to sensor resistance
Send readings to temporary storage
Calculate hourly minimum and maximum values
Send hourly values to permanent storage