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A. Software Development life cycle

1. Planning and Requirement Analysis

In ABUAD farm, Ado Ekiti, the farm is facing problem of irrigation during dry season, and we all know water is the basic need of agriculture. The irrigation known as drip irrigation could be the one that can solve the problem during dry season. The aim of this project is able to provide reasonable amount of water to the crop, this system is an attempt toward smart irrigation concept.

An electronic device is responsible for sensing the temperature and determines the moisture condition of the soil as well configuration of the time interval for the water system with an alarm that triggers when there is insufficient water in the irrigation tank and the encryption (Password) to the system, only given access to an authorized personnel.

A Bluetooth device is added to the hardware device, the sensed environment condition are taken and send to the server, which has a MySQL database for the storage of data/records. The sensor node are deployed into the irrigation field for sensing the soil moisture valves and the sensed data is send to the controller node ,on receiving sensor valve the controller node checks it with required soil moisture valve.

When soil moisture in the irrigation field is not up to the required level then the alarm is switched automatically on to irrigate the associated agricultural field and messages are sending to authorized personnel. Smart irrigation system estimate and measure diminution of existing plant moisture as well as temperature.

In order to operate an irrigation system the restoration of water into the irrigation tank is needed, irrigation frequency and water used are important to enable such be a success there should be a proper irrigation scheduling strategy; it has a security

system to ensure security of pumps and other equipment. A wireless system provides information to the owner about the pumps condition, the rainfall and any unauthorized access. If this system is implemented for irrigation, it will reduce those problems.

2. Defining requirement

The main requirement of this system is to provide correct readings of the sensor on the app. By using the app authorized personal can ON/OFF the irrigation node using the Bluetooth, and by using the automated valves water can be supplied to the farm , to enable the sufficient grow of plant ,the plant require an efficient method of delivering water as well as a configure time interval of water supply to the plants with the right amount of water and at the right time.

- **Irrigation system based on wirless sensor network**

The irrigation system will work automatically with the use of **WSN (Wireless Sensor Network)** and **GRPS(General Packet Radio Service)** module having the goal of optimizing usage of water. This irrigation system generally consists of soil moisture and temperature sensor in **WSN** within the distributed network. The unit known as gateway its purpose is to transfer data from the sensing unit to the base station, then the **actuator** perform the function to control the irrigation on given commands also managing the data from the sensing unit for controlled water supply over the field in required and depending on the condition of the field the specialized algorithm is used. The main function of the algorithm is to give command to the **actuator** to provide controlled quantity of water through the valves the algorithm is programmed into microcontroller.

METHODOLOGY: The system computation is totally based on the micro-controller. The automated irrigation is served by the **WSN** in order to perverse water, the soil moisture sensors and the soil temperature gives live reading. The devices present sensor nodes are **soil moisture sensor, temperature sensor , microcontroller unit and transceiver .**The data gathered from the sensor is transmitted to microcontroller and communicating from gateway to nodes are done through the WPAN .The data is transferred using GRPS protocol , internet connection allow internet data inspection of current soil moisture and temperature valve with a graphical representation .

- **Automated Irrigation Control**

The wireless sensor network alarm system is useful to farmer for precision agriculture. The application monitors the whole farm from remote location using IOT (internet of things). This will configure the time interval of the water system

works on sensor network there are three Microcontrollers in Microcontroller unit (MCU).

Two Microcontrollers are used to control gate valve by monitoring sensor and give information to third (middle) Microcontroller. This Microcontroller takes decision that pump will be on or off.

METHODOLOGY: There are two pumps connected to the Microcontroller (MCU), Pump1 & Pump2. Pump1 is used to supply water in the land and Pump2 is used to remove excess water from the land. In each field there are gate valves and water level detectors which detect three water levels. Each gate valve and water detector is connected with the MCU. According to the water level detector MCU controls the gate valve.

Wireless system consists of **encoder, decoder IC's and radio frequency transmitter, receiver circuits**.

- **Security system**

The security system which is based on IR **(Infrared Radiation)** sensor. The basic principle of IR sensor is based on an IR emitter and an IR receiver. IR emitter emits infrared continuously when power is on. On the other hand, the IR receiver works as a voltage divider.

METHODOLOGY: IR receiver can be a transistor in which base current depends on the intensity of IR light received. Any obstacle due to any access between the IR emitter and IR receiver decreases the intensity of IR light which increases the resistance between collector and emitter terminal of transistors ,this results into high output voltage across the IR receiver which is connected with a microcontroller.

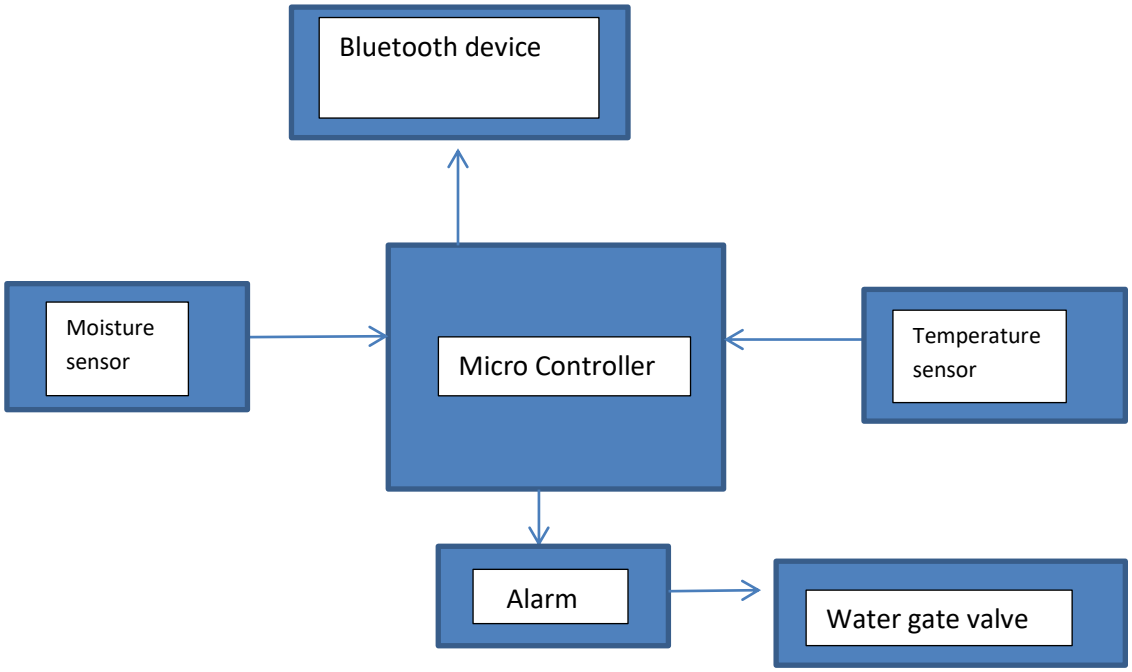
The microcontroller is devised to check the condition of signal received from IR sensor and password button. If the access is through proper **password a message "security ok"** is passed to the owner of the land. Otherwise there is **another message "security alert" along with an alarm** ring passed to the owner.

3. System Design

The entire system may be discussed into 3 steps: Monitoring system, wireless messaging system and security system.

A. Monitoring System:

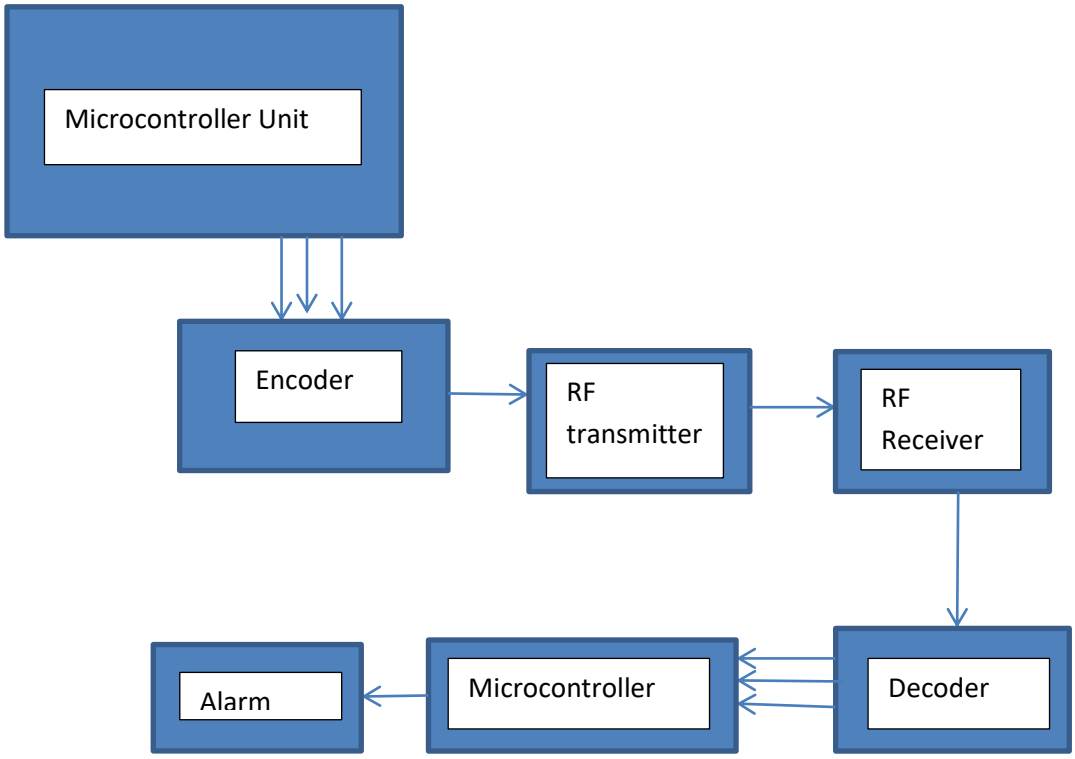
The components of the water level control are water sensor, Temperature sensor, moisture sensor, gate valve and microcontroller; these sensors are used to calculate the amount of water required for particular crops, at what amount of time and the temperature of the soil.



: Diagrammatic Representation of the of the irrigation based on wireless network or monitoring system

B. <u>Wireless Messaging system:</u>

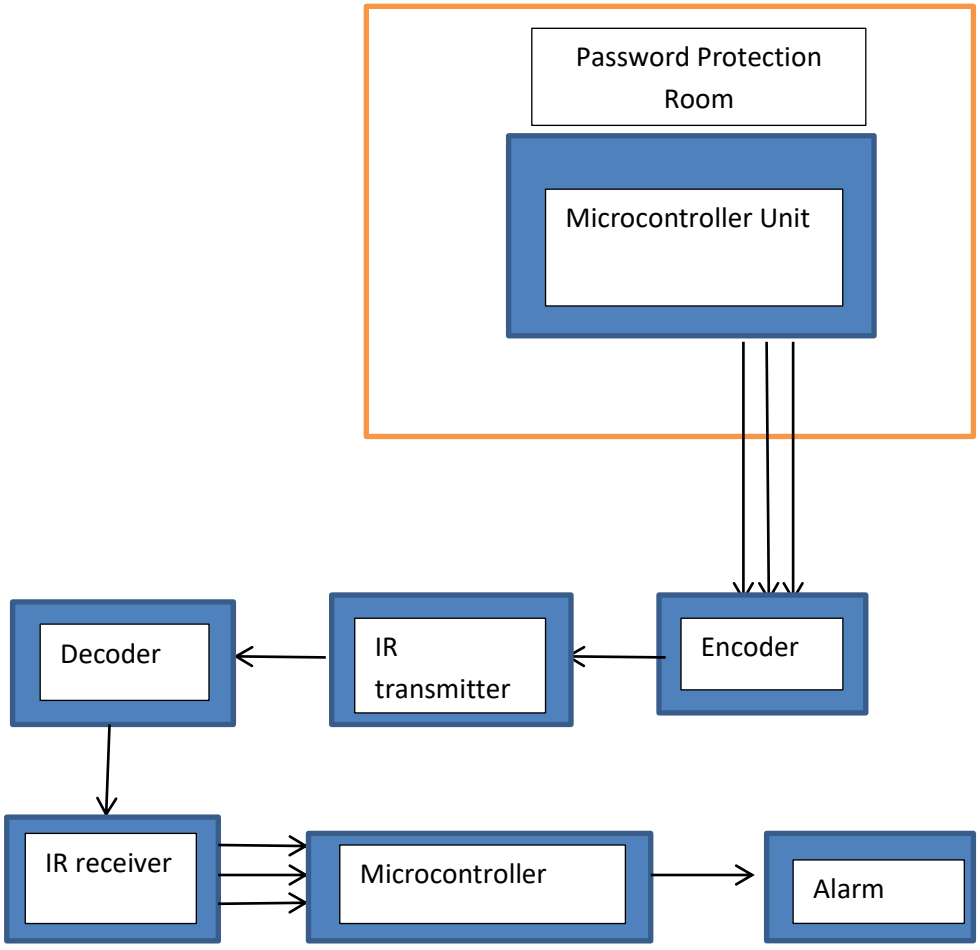
The wireless messaging part consists of encoder, decoder, and RF transmitter and Receiver (Bluetooth device).



: Diagrammatic Representation of the wireless messaging system

C. <u>Security System:</u>

This consist of basic principle of IR (Infrared Radiation) sensor is based on an IR emitter and an IR receiver.



: Diagrammatic Representation of the Security System

4. **Building**

The Microcontroller unit provides the microcontroller integrated development environment (IDE), which is a cross platform application written in the programming language Java. It is come from the IDE for the languages Processing and Wiring. It was created for people who do not have knowledge about electronics. It includes a code editor which provides syntax highlighting, brace matching, cutting/pasting text, searching/replacing text and automatic indentation, and also simple one-click mechanism to compile and upload programs to an microcontroller unit board. It also provides a message area, a text console, a toolbar with buttons for common functions and a series of menus.

5. **Testing**

LIMITATIONS:

- Environmental changes not consider for sensor reading. System user is not able to program application. There is no controlling system for application.
- System use linear programming for maximum profit on defined resources. It causes problem where constrain and objectives are not define. In real time situation object and constrain are not predefined then this system cannot be used.
- Data change as per geological and soil condition system does not work suitably. This system works on Naïve Bayes algorithm for irrigation control. Algorithm works on previous data set for decision making if any attribute is not frequent result is zero.
- Automated irrigation system uses only two parameters of soil like soil moisture and temperature other parameters humidity, light, air moisture, soil ph value not taken for decision making. This system works on soil moisture and temperature sensor threshold value.

6. **Deployment /conclusion**

The work is successfully designed, assembled and tested. This automation in the irrigation system is based on both hardware and software the idea of automated irrigation and also the idea of a security system. Though soil moisture sensor as well as temperature sensor. The password controlled security system can also be used to ensure security for any room and place as required, and providing wireless message system with easy installation and improved monitoring facility. Here the approach

was the conservation of water which was implicated in use of irrigation. So by looking forward developing a automated irrigation system was the Aim. The automated system would be proposed with help of WSN, microcontroller, Bluetooth, GCS. The lone attention of sensors is to gain physical parameter from soil and environment which would be monitored and then given to the control unit for the further action. The further action could be taken place by actuators.

B. System Architecture (Hardware/Software) Application

The System Architecture for Smart Irrigation System are given below in which

Hardware

- **RF Transmitter/Receiver (Bluetooth Module HC 05/06 2**):
  Bluetooth is a wireless connectivity device which is use to provide wireless connectivity. The Arduino-Bluetooth device is use to provide connectivity with the aduino device by using Bluetooth we can control the arduino form our smart phone. This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter and receiver (Tx/Rx) pair operates at a frequency of 433 MHz.
- **Microcontroller (Arduino):**
  Arduino is a microcontroller based kits for building digital devices and interactive objects that can able to sense and control the physical devices. An Arduino board consists of an Atmel 8-, 16- or 32-bit AVR microcontroller. With some components that provide programming and incorporation into other circuits. Important part of arduino is that it provide standard connecter, which connect the CPU board to a various type interchangeable add-on modules termed shields, the Arduino provides the Arduino integrated development environment (IDE).
- **LED (Alarm):**
  The LED (Alarm) the primary function of the alarm output aspect of a system. Occupant signaling components include various audible and visual alerting components, and are the primary alarm output devices. Bells are the most common and familiar alarm sounding device, and are appropriate for most building applications
- **Android device** :
  An Android device is a device that runs on the Android operating system. Android is an array of software intended for mobile devices that features an

operating system, core applications and middleware. An Android device may be a smartphone, tablet and PC.

- **Encoder:**
  The encoder uses a 'medium' to send the message as (signal) to a phone, email, or other communication tool. They are capable of encoding information which consists of N address bits and 12_N data bits. Each address/ data input can be set to one of the two logic states.
- **Decoder:**
  The decoder is used as a medium to convert message (signal) into Instructions. The decoders receive serial addresses and data from a programmed 212 series of encoders that are transmitted by a carrier using an RF transmission medium, decoders are capable of decoding information's that consist of N bits of address and 12_N bits of data [12].
- **Temperature sensors:**
  These temperature sensors vary from simple ON/OFF thermostatic devices which reads the temperature of the water. A temperature sensor is of two basic physical types they are **Contact Temperature Sensor** and **Non-contact Temperature Sensor.** Again this sensors are divided into three groups of sensors, Electro-mechanical, Resistive and Electronic .Among all this the **thermistor sensor** are most commonly used for agriculture.
- **Moisture sensor:**
  A soil moisture sensor is put into the soil and measures how much moisture is in the root is present. It allows your irrigation system to match the amount of water applied with the amount of water needed by the plants. It allows irrigation if more water is needed or prevents irrigation if the soil is already wet from rainfall.

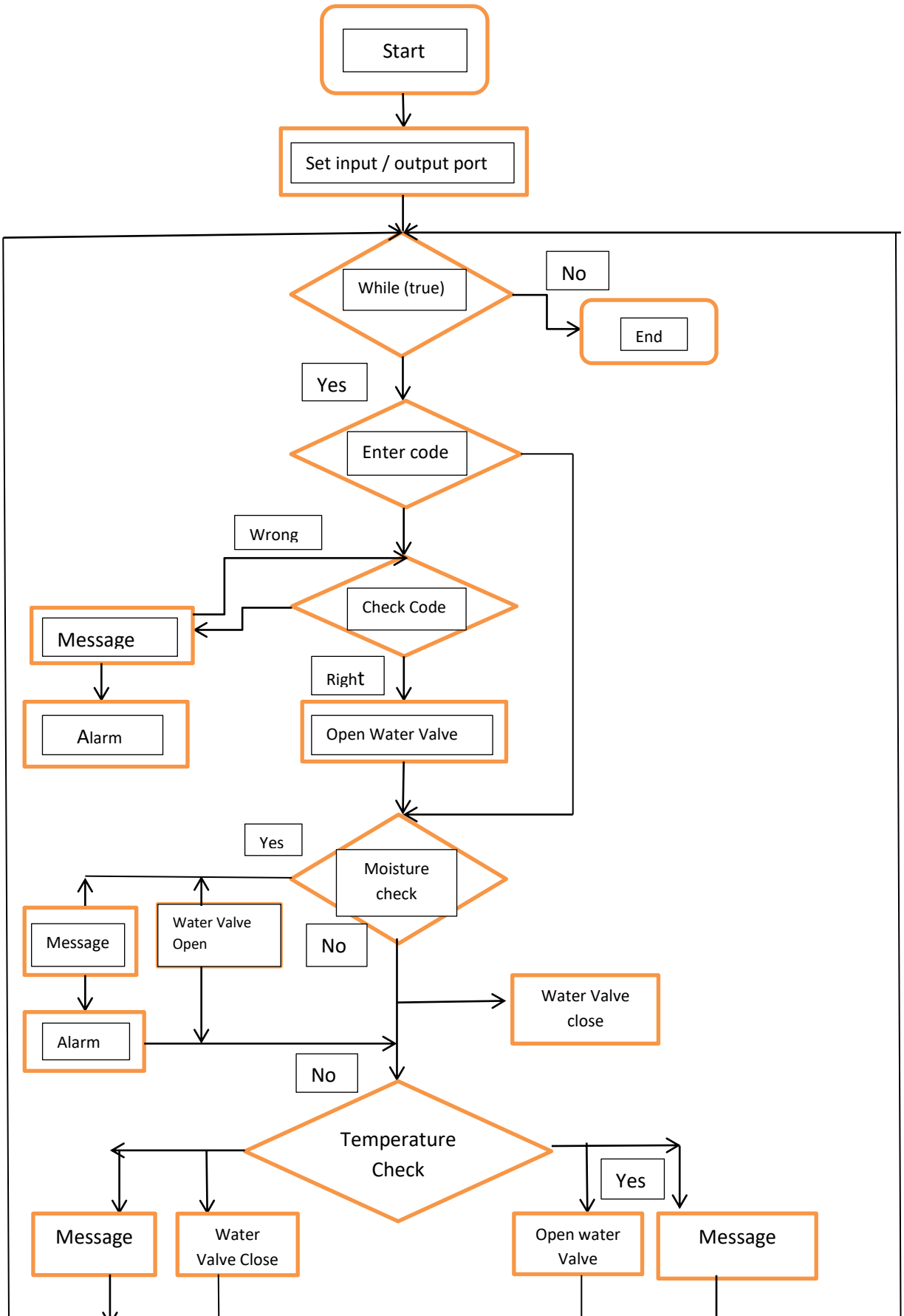
Software

- **Arduino IDE**:
  The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

- **Android Studio:** Android Studio is the official integrated development environment (IDE) for Android application development. It is based on Intelli

IDEA, a Java integrated development environment for software, and incorporates its code editing and developer tools.

C. **Flowchart/Algorithm.**



: Flow-Chart of the Irrigation system

Algorithm of the irrigation system

Step 1: Start

Step 2: Set Input/output ports

Step 3: while (true)

If true go to step 4

: ENDIF

Step 4: Enter code

If code is correct go to step 5

: ELSE

If the code is wrong send a message and sound the alarm

: ENDIF

Step 5: Check moisture level

If moisture level is normal go to step 6

: ELSE

If moisture level is low Open water Valve (irrigation tank)

: ENDIF

Step 6: Check Temperature level

If temperature is high open water Valve (irrigation tank)

: ELSE

If temperature is normal close Water Valve (irrigation tank)

Step 7: check water level

If water level is low send a message and trigger the alarm

: ENDIF

Step 8: END

D . Design Approach of the Irrigation system