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Mechatronics Engineering.

Automated Irrigation System.

OBJECTIVES:

- Read the temperature of the soil.
- Determine the moisture content of the soil.
- Configure time interval for the water system based on the above.
- Triggered an alarm if there is no sufficient water in the tank for the irrigation.
- Enabled password for the system.

CONCEPTUALIZATION.

The irrigation of the ABUAD farm during the dry season has been an existing issue as timely watering is not always practiced. Therefore an adequate solution to this problem would be automating the entire system.

The automated irrigation system software is one that is designed to apply/ sprinkle water onto the crops as well as the farm land on its own thereby making the work of the farmer easier. It is intended to solve the problem that comes with the dry season as it regulates the amount of water being delivered to the farm land on its own by the use of sensors such as temperature, soil moisture and water level sensors. The software has interactions with the hardware, thereby controlling it to perform certain functions like activating the sensors, triggering the alarm system and delivering the water through the sprinklers. The system is aimed at improving efficiency of irrigation as a whole.

SPECIFICATION.

The software would be able to do a lot of things. It would perform logical operations as well as control the hardware devices. Various functions that would be performed by the software include:

- Performing a security check to access the system with the use of a security key;
- Activating the sensors which would check the soil temperature and moisture content as well as the water level in the tank;
- Performing logical operations as well as checks on the data received from the sensors;
- Activating the alarm system, water pump and sprinkler system based on the result of the logical operations performed on the data;
- Triggering the alarm system if the water level in the tank is too low
- Sending a warning signal if the temperature is too high;
- Sending a warning message for low soil moisture as well as activating the sprinklers in response to this;
- Activating the pumps to increase the pressure of the water being delivered from the tank as well as the one being sprayed by the sprinkler;
- Utilising the valves to prevent the backflow of fertilizers or other chemicals into the water tank;
- Determining whether the soil is too hot;
- Determining whether the moisture in the soil is just enough for the usage of plants;
- Adequately distributing water to the plants as well as the land according to their requirement thereby improving the efficiency of watering.
- Terminating the system once the stop button is pressed.

DESIGN.

This involves the design of an algorithm and a flowchart to show the path the system takes after testing for the conditions of the various modules. This shows the alternative routes to be taken in the occurrence of certain events. It presents the overall idea in a simpler way to understand as majorly depicted in the flow chart.

ALGORITHM FOR THE AUTOMATED IRRIGATION SYSTEM

Step1: Start

Step 2: Key = password

Step 3: Soil Moisture, Soil Temperature, Water Level = 0

Step 4: Read Password

Step 5: If Password == Key

Activate Sensors

Else

Print “Wrong Password”

Go to Step 4

Step 6: Collect data from sensors

Step 7: If Water Level < 2Litres

Activate alarm

Print “Tank refill required”

Go to Step 6

Else

Print “Water level is suitable”

Step 8: If Soil Moisture < 50%

Print “Soil Moisture is low”

Activate Sprinklers for 20 minutes

Else

Print “Sufficient Moisture Content”

Step 9: If Soil Temperature > 40℃

Print “Soil Temperature is high”

Wait 20 minutes // this is to make the time interval between watering to be smaller in dry season.

Else

Print “Soil Temperature is good”

Wait 120 minutes

Step 10: if Stop button is pressed // this causes the continuous looping of the program until the stop button is pressed

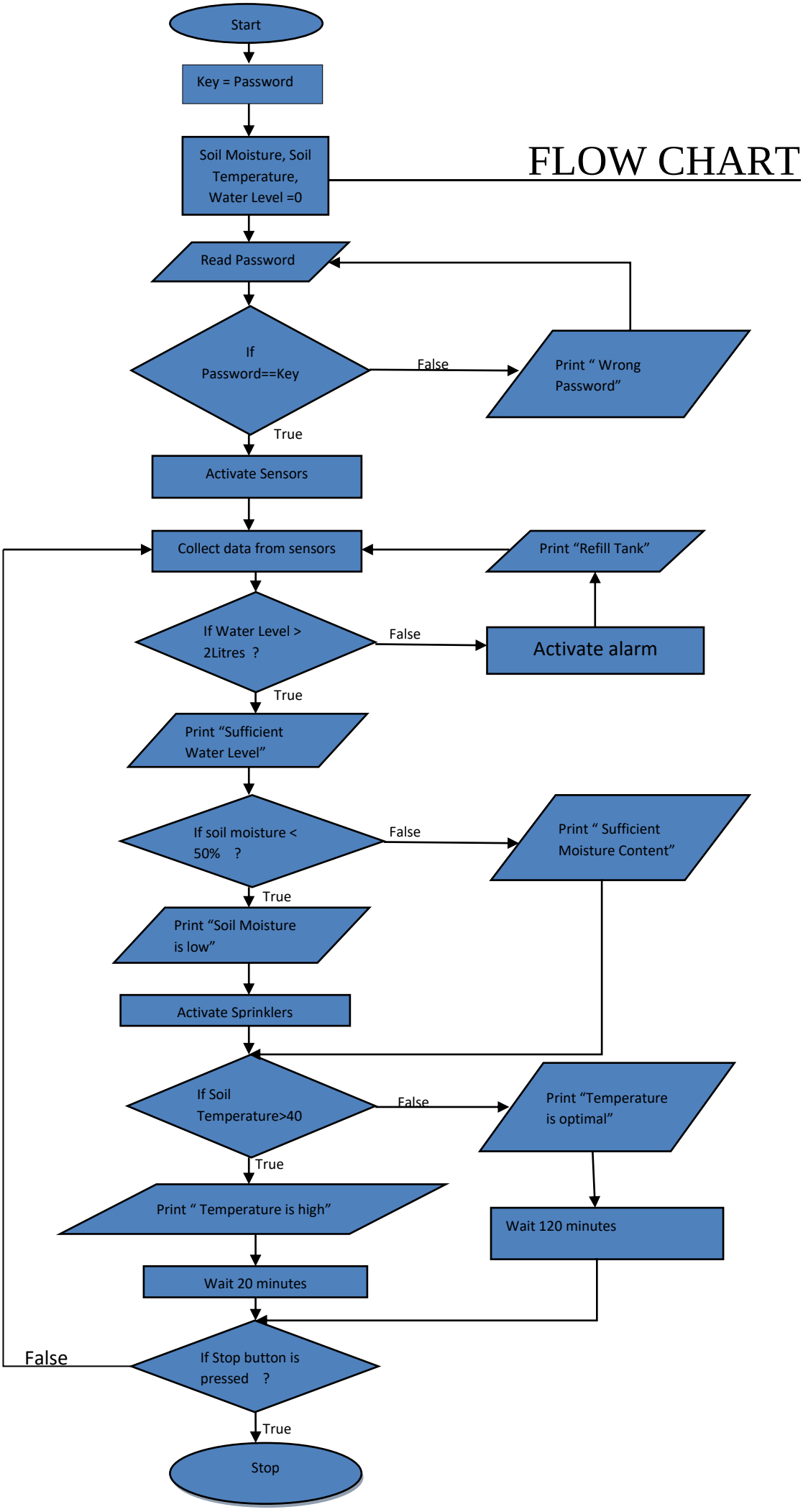
Go to step 11

Else

Go to step 6

Step 11: Stop

FLOW CHART


Start
Key = Password
Soil Moisture, Soil Temperature, Water Level =0
Read Password
If Password==Key
False
Print " Wrong Password"
True
Activate Sensors
Collect data from sensors
Print "Refill Tank"
If Water Level > 2Litres ?
False
Activate alarm
True
Print "Sufficient Water Level"
If soil moisture < 50% ?
False
Print " Sufficient Moisture Content"
True
Print "Soil Moisture is low"
Activate Sprinklers
If Soil Temperature>40
False
Print "Temperature is optimal"
True
Print " Temperature is high"
Wait 120 minutes
Wait 20 minutes
If Stop button is pressed ?
False
True
Stop

IMPLEMENTATION.

The application would be coded in **C++** programming language one of the high level languages. The entire system would be controlled by a microcontroller which would be coded in **C++**

TESTING AND DEBUGGING.

The intended code once written is subjected under a series of tests and simulations. This would help in the detection of logic as well as syntax errors before the release of the program for final use. This would be the stage in which “debugging” takes place. The use of break point would be effective in determining the location of the errors that may possibly be embedded inside the code.

RELEASE AND UPDATE.

Once debugging has been successfully carried out, the program would be ready for use. Therefore it is released to the potential user and feed back is obtained. The purpose of the feedback is to ascertain the performance level of the program and search for possible optimization strategies. In case of future optimization/ update, the update is also released to the systems thereby also being implemented.

HARDWARE AND SOFTWARE FEATURES.

Hardware Features

The hardware consists of lots of part which range from the sensors to the Programmable Logic Controller and back to the actuator (which include the sprinklers). The hardware components include:

The soil moisture sensor (Tensiometer)

The soil temperature sensor (Thermocouple)

The water tank

The delivery pipes

The water meter

The microprocessor

The Alarm

The computer (houses the microprocessor)

The water pump

The sprinkler

The control valves

The stop button (to terminate the water system cycle)

The tensiometer: this measures the soil moisture in terms of suction pressure. It is made up of a tube filled with water which possesses a ceramic tip at one end and a rubber at the other. The ceramic is porous to allow the flow of water into and out of the equipment. When the soil moisture is low, water leaves the equipment to the soil and therefore crating a partial vacuum in the system. This vacuum is read using a vacuum gauge. Therefore the magnitude of the suction pressure determines the magnitude of water lost from the system and therefore approximates the soil moisture content.

The alarm: the alarm is triggered by the water meter when it reads low. It is intended to remind the user to refill the water tank thereby making the irrigation possible.

The thermocouple: this is made up of probes which are injected into the soil. The differential in the temperature of the two probes translates into and electrical signal which is then converted to tell the approximate pressure.

The water tank: This stores the water used for irrigation.

The delivery pipes: This carries the water from the water tanks all the way to the sprinklers.

The control valves: These are installed in the pipes and ensure that chemicals such as fertilizers do not flow back through the pipe into the water tank.

The stop button: this helps to terminate the program. Without which the program continues in an endless loop.

The sprinklers: these are placed at strategic positions and help to deliver a predetermined amount of water to the soil.

The pump: this supplies the suitable pressure by which the water uses to pass through the pipes and also the pressure at which the water is broadcast through the sprinklers to the soil

The computer and microprocessor: this houses the microcontrollers which are programmed with a high level programming language (java). The embedded code, through the microprocessor controls the entire system

The water meter: this is a metric measurement of the amount of water present in the water tank.

Some ***features*** that would be possessed by the hardware listed above include;

Programmability: majority would be able to be controlled using written programs.

Input and Output: They would be able to take in stimulus and convert them into electrical signals which would be passed across.

Software Features

The software must be very detailed in its design and posses possible solutions to all the requirements of the user. The software would be developed with C++ programming language and would therefore would need to be converted to machine code using a translator. The structure of the software is a bit complex.

Some software features include:

Access Control

Translation

Logic operations

Cyclic process

Data base System

Hardware Interaction.

Graphical User Interface

Access Control: This is implemented in the program by using a password check. It checks the password entered with the one stored in the data base. If it correlates access is granted otherwise access is denied

Translation: Embedded programs would be used to convert the high level programs to machine code that would be understood by the hardware.

Logic Operations: this involves checks on information inputs and performing actions based on the result.

Cyclic process: The software has a continuous loop which only ends when the stop button is pressed. This avoids the stress of typing the password every time a sensor check is required.

Data base System: the software possesses means to store the information obtained within a data based enabling the user to check previous data from time to time and make reasonable predictions.

Hardware Interaction: the software is able to interact with the available hardware and enable them perform specific task. It sends information to the hardware as well as collects.

Graphical User Interface: the software would be able to interact with the user in a very easy manner thanks to GUI. The displays would be done on the computer screen and that would be the location of data input as well.

The programming Technique chosen is the top-down design.

TOP – DOWN DESIGN.