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Question A

Software Development Cycle

APP NAME: HYDRO SMART

CONCEPTUALIZATION

This section details the overview of a solution to the irrigation problem faced by the ABUAD farms during the dry season. Giving the option of automating the system, a software has been developed to resolve the problems faced by the farm. The “HYDRO SMART” software is a human interactive one that receives information from the user which then translates to instructions for the automated irrigation system. The automated irrigation system would be controlled by the “HYDRO-SMART” app to work round the clock supplying water to the crops at specific times whilst also performing other remote functions on the farmland.

How does the app work?

With the aid of the *drip irrigation system* employed by the ABUAD farms, wireless sensors are connected to a network of valves, pipes, tubings, emitters on the farmland. All information is communicated with the aid of electrical signals, a controller which is connected to the sensors automatically switches on/off the motors which then delivers water supply to the crops following programming instructions from the “HYDRO SMART” software. The above being the main function

of the software. “HYDRO SMART” can be used on electronic devices such as laptops, phones and tablets. It has a graphical user interface that enables the user interact actively with its functions, some of the features possessed by the software include; the ability to read the temperature of the soil, determine its moisture content and also an alarm that triggers when there is a shortage of water for the crops. The apps functionality has solved the problem of needing to manually control the operations of the drip irrigation system as this has been in previous times, prone to human errors and laxity.

SPECIFICATION

This part details the applications software and hardware features, carefully sectioning them into modules as addressed below:

SOFTWARE FEATURES	HARDWARE FEATURES
GRAPHICAL USER INTERFACE(Subsets are below)	SOIL TEMPERATURE SENSOR
*USER LOGIN	SOIL MOISTURE SENSOR
*WATER PLAN SCHEDULE	ALARM SYSTEM
*SOIL TEMP. READER	TIMERS
*MOISTURE CONTENT READER	DRIP IRRIGATION EMMITERS
*MANUAL OPERATIONS	FERTIGATION/CHEMIGATION DEVICES

*ALARM TRIGGER	DEVICES WITH INTERNET ACCESS
*DISPLAY BOX	WIRELESS SENSOR NETWORK
WIRELESS INFORMATION UNIT & WEB APPLICATION	

DESIGN

The design stage involves all the steps taken to develop the “HYDRO-SMART” software from inception to putting it out for testing and debugging. The steps listed below are detailed and discussed about in this design stage:

1. Sketching the “HYDRO-SMART” software application
 2. Workflow of the “HYDRO-SMART” application.
 3. Wire framing the user interface
 4. Testing
- **SKETCHING STAGE:** During the sketching stage, navigation, buttons and other interactive elements that would help the app user communicate actively with the drip irrigation system are incorporated. Each page on the web application is going to be drawn, placing the necessary function buttons in their respective domains, this serves as the foundation for the designing the irrigation software.
 - **WORKFLOW:** This details how to make the software easy and functional in the hands of any user assigned to it, some of the various workflows that would help the software’s operation include:

- i. How to login in to the ABUAD farms irrigation system
 - ii. How to trigger the distribution of fertilizers/chemicals on the farmland
 - iii. Using the water plan schedule
 - iv. Navigating through “MANUAL OPERATIONS” to personally oversee the irrigation system operations
 - v. Using the moisture and temperature functions
 - vi. Triggering the sensor devices
- **WIRE FRAMING THE USER INTERFACE:** Wire framing is the process of designing a blueprint of your software web application while prototyping is taking wire framing a step further, adding an interactive display. Both of these can be done with the use of AdobeXD ; a wire framing/prototyping tool.
 - **TESTING:** After the software application has been developed, a few test runs are made to make sure its functionality is on point.

IMPLEMENTATION

This phase involves the construction of the actual project result. Software programmers are occupied with encoding, designers are involved in developing graphic material, and the actual reorganization takes place.

TESTING AND DEBUGGING

This means verifying correct behavior of the app making sure its error free as this of great importance. The irrigation system software has a very big task on its shoulder; a single malfunction would cause the ABUAD farms a lot of money. Testing and debugging is going to make sure that the apps functionality remains at its peak throughout its usage with the farms.

RELEASE AND UPDATE

The “HYDRO SMART” software application does not require a release or update. It is not for the public but rather for the sole usage of the ABUAD farms. Although, there is always room for improvement if more technologies discovered are to be integrated into the irrigation system.

Question B

SOFTWARE AND HARDWARE FEATURES

Software Features

1. GRAPHICAL USER INTERFACE: The GUI composes of every single function that the user of the software application can interact with. It comprises of all the visual elements, all the functions are detailed as follows;
 - a. USER LOGIN: This function enables the user of the software application to access a password administrator account that controls the irrigation system.
 - b. HOME PAGE: Once logged in into a user admin account, the home page is displayed. The “HYDRO SMART” app only has one webpage where it conveys all the functions needed. The interactive functions displayed on the page are detailed below;
 - i. WATER PLAN SCHEDULE: This allows the user to schedule the appropriate times for water distribution throughout the farmland. It lets the user pick the time, amount and regularity of water flow. With a simple and understandable interface, any staff with a basic tech knowledge can navigate this aspect of the “HYDRO SMART” application.

- ii. **SOIL TEMPERATURE CHECKER:** This displays the results of the irrigation systems soil temperature sensor, the sensor already programmed to take temperatures at strategic times of the day. The results from the readings are sent as electric signals and displayed on the electronic device being used to run the software application.
- iii. **MOISTURE CONTENT CHECKER:** This also allows the user to access the information sent from the soil moisture content sensor, with the aid of electric signals it displays the result of the measurement.
- iv. **MANUAL OPERATIONS:** All operations for the automated irrigation system require very little human input but with this app function, a user is allowed to take the helms of the system and control everything manually, right from the sensor readers to the water flow regulation. The user is able to control fertigation/chemigation operations through this medium.
- v. **ALARM TRIGGER:** This function triggers the alarm system automatically once it detects a shortage of water in the tank for irrigation. It flashes red lights on the application to indicate the above whilst also sounding the actual alarm system.
- vi. **DISPLAY BOX:** This is a visual representation of all the settings/programmings of the automated irrigation system. The amount of water being supplied, the fertilizer/chemical intake, timing for water distribution etc. The importance of this is that it gives the user an easy way to monitor the operations of the automated irrigation system.
- vii. **WEB APPLICATION:** Graphical user interface software was developed for real-time monitoring and programming of irrigation based on soil moisture and temperature data. The software application permits the user to visualize graphically the data from each wireless sensor unit online using any device with internet.

Hardware Features

- I. *Soil temperature sensors(STO1)*: These are high quality temperature sensors that are specifically designed to measure soil temperature in extreme conditions hence their suitability for the automated irrigation systems. Following instructions sent through signals from the “HYDRO SMART” application, they measure the temperature of the soil and relay the data back to the software application.
- II. *Soil moisture sensors*: Working with the same principle as the STO1, the soil moisture sensor would measure the volumetric water content of the soil and send the data through electric signals.
- III. *Alarm System*: This is triggered once the water in the tank mean for the irrigation runs low, sounds are rung out and the information is conveyed to the software application.
- IV. *Timers*: These are used to control all the automated irrigation devices, they determine when the crops would be watered, moisture and temperature sensors would work etc.
- V. *Drip irrigation emitters*: These are the devices that are used to supply water and occasionally fertilizers to the farmland, with sensors connected to the “HYDRO SMART” software; they work in accordance to the instructions from the application.
- VI. *Fertigation/Chemigation Devices*: These are used to supply the right amount of fertilizers and chemicals to the crops, working under the same principle as the drip irrigation emitters.
- VII. *Devices with internet access*: Smart phones, laptops, tablets etc used to access the internet.
- VIII. *Wireless sensor network*: A WSN is comprised of a radio frequency transceiver, sensors, a microcontroller, and power sources. Several WSNs can be deployed in-field to configure a distributed sensor network for the automated irrigation system.

Question C

ALGORITHM

Step 1: Start

Step 2: Login to the “HYDRO SMART” software application

Step 3: Read all measurable quantities from the farmland using the automated irrigation sensors

Step 4: Display all measured quantities in the “DISPLAY BOX”

Step 5: Configure time intervals for water distribution

Step 6: IF settings need to be updated/ Operations need to be performed – switch to “MANUAL OPERATIONS”

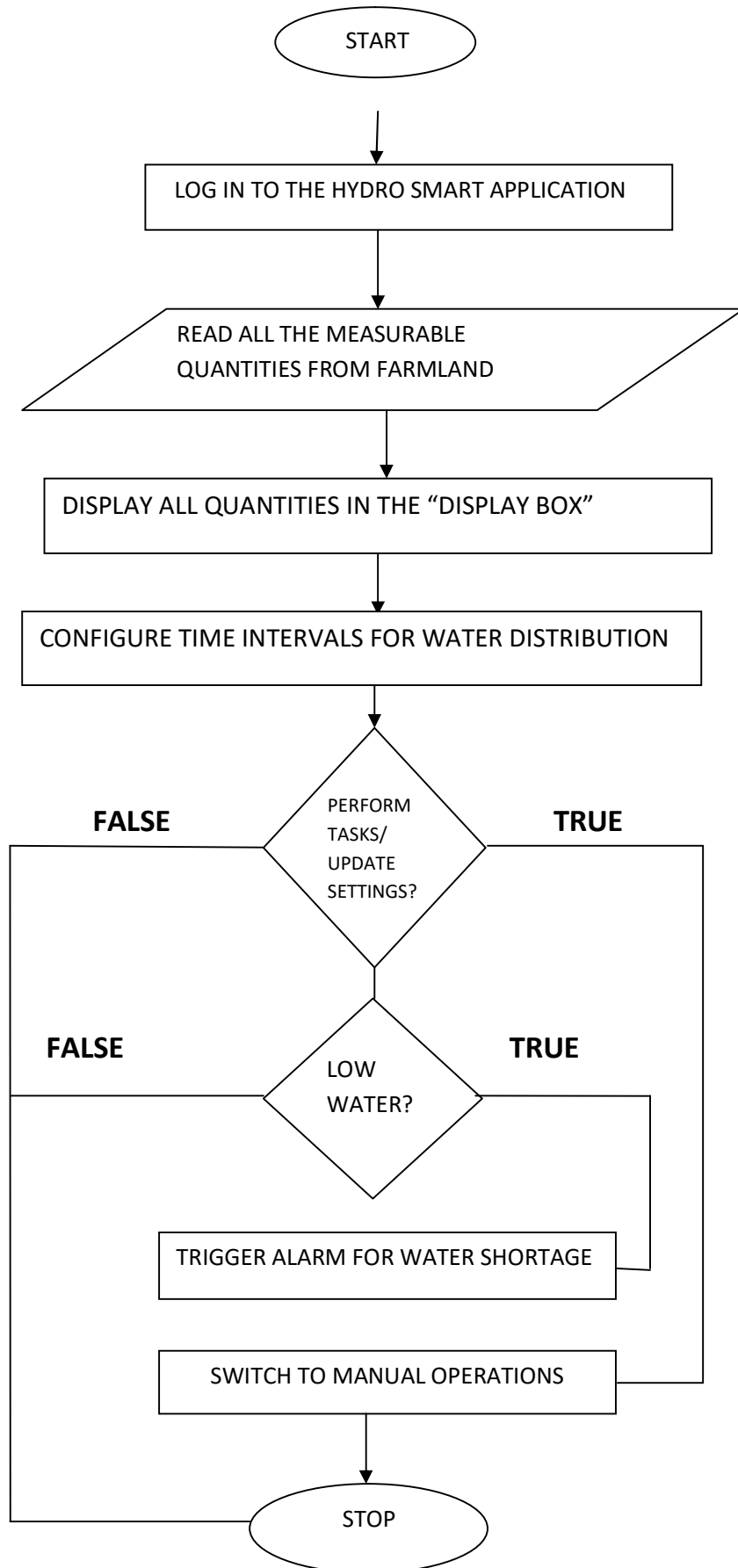
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Step 7: IF water content in irrigation tank is low, trigger alarm

ELSE

Step 8: Stop

FLOWCHART



Question D

TOP DOWN APPROACH OF THE SOFTWARE'S DESIGN

HYDRO SMART SOFTWARE

