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COURSE:

STRUCTURED PROGRAMMING (ENG 224)

APPLICATION DESIGN USING SOFTWARE DEVELOPMENT LIFE CYCLE:

This projected was initiated upon the realization of the need to automate specific functions on the Afe Babalola University Ado-Ekiti (ABUAD) school farm. Discussing the project scope, the said function to be developed was ergo understood to be the farm's irrigation system. Now, the farm has always had a manually controlled irrigation system but this development process intends to improve on that; automating the irrigation system so as to perform the following functions in real-time: Read the temperature of the soil, determine the soil's moisture content, configure time intervals for the dispel of water, trigger an alarm to notify insufficient/non-availability of water in the irrigation tank, and finally to enable a password for the system so as to ensure only authorized personnel have access to the control and further workings of the newly automated system. This automated irrigation system is to provide a non-hands-on approach to the watering process, cost-effectiveness as it provides water to the farm exactly where and when it's needed, which cuts down utility bills significantly and offsets the initial cost of setup. The automated system could and would end up paying for itself within years whilst boosting the farm property value. Most especially, these automated irrigation systems are efficient, conserving water, providing precise coverage and eliminating problems of over or under-watering the farm. The timers can be set for daily or weekly watering, and at times of low evaporation. Additionally, "smart" moisture sensors can be installed for many systems. These measure precipitation rates in real time, and activate only when your soil is dry.

At the platform/application development, the system's functionality is decided upon.

The system is mainly sensors and not much of application development. However, the system could be monitored using computerized controllers. This is vital due to field anomalies such as perched water tables, surface drains, and rock outcroppings with the need to deliver depths of water to specific areas of the field. With these computerized controllers, producers can obtain knowledge of whether the system is operating on a real time basis by communicating with the machine to determine operating status. With this system, soil moisture content, temperature and humidity are measured every few seconds using moisture sensors. If the moisture in the sol falls below a minimum threshold for the agricultural crop in the land, the system sends a wireless message to the valves in the irrigation pipelines, including the valve controlling access to the main water source, causing the power supply to valves to be altered, opening them and allowing water to flow into the land for crop irrigation. Soil is continuously measured throughout the entire irrigation process. When the moisture level/content in the soil rises above a set maximum threshold for the crop, the system sends another wireless message to the valves in the irrigation pipelines, altering the power supply to the valves to shut them and cease irrigation.

The system was initialized with comparable reference values to determine whether or not to open or cease the irrigation valves with access to the main water source. These moisture level reference values are compared in real time to the farm soil actual moisture content and the required action is performed as stated in the previous paragraph with regards to this actual moisture content value being greater than or less than the initialized reference values for the moisture content. Another is set to ensure the water source doesn't ever go below the "full" mark.

At the solution stabilization stage, a test automation specialist ensures that the system worked as intended. The system was tested across the course of a few months with the performance of farming operations before and after the introduction of the system recorded and compared and it was found that the automated irrigation system performed as intended.

After that, the system was officially integrated into the ABUAD farm's farming processes. I have been working closely with the farm manager since then, offering upgrades to the system and correcting defects where deemed necessary.

CRITICAL DISCUSSION OF THE SOFTWARE AND HARDWARE FEATURES:

Once a land section had been identified for the automatic irrigation, the real time feedback installation for the particular land is designed and analyzed using an automated irrigation system pipeline network optimization software owned and patented by RACETT CANADA INC and RACVETT NIGERIA LTD. The user inputs the area of the land to be irrigated, the type of automatic irrigation required, and the crop being cultivated on the land. This information was in turn utilized to calculate the number of irrigation blocks needed for optimum irrigation, the number of monitoring units and control units, and pipeline valves required, the length of the irrigation pipeline needed, and the number of outlets or sprinklers needed (in this case, would be needed).

This information was also used to calculate the acceptable range of soil moisture content, outside of which the system would automatically turn on to provide irrigation. Sensors, as earlier stated, were required to determine when the automatic irrigation system needed to be turned on. The system incorporated in the ABUAD farm is water irrigation. Therefore, the amount of moisture in the soil will be the primary measurement used in determining the threshold for switching on the system, as well as humidity. Some of these sensors to be used include: Moisture level sensor, humidity and temperature sensor, liquid level sensor.

Some of the hardware features include:

Development Board: It enables the automated irrigation system autonomously detect the environmental data necessary to determine whether or not irrigation should commence or cease. The development board therefore used in this system is the Arduino Mega.

XBee: XBee Pro 900HP wireless modules were used to establish wireless communication between the monitoring unit of the automated irrigation system and the valves in the irrigation pipelines to instruct the valves when to open and close for irrigation. The XBee Module is mounted on the Arduino Mega using an XBee Shield. With a high gain antenna, this module can establish a wireless connection between the monitoring unit and the pipeline valves from distances as far as 45km.

Irrigation Pipes: The system made use of aluminum irrigation pipes. The diameter of these pipes depended on the availability of the water source and the source and size of the land to be irrigated.

Irrigation Pipeline Valves: Irrigation valves are placed at strategic locations within irrigation pipes to control the flow of water. By closing or opening these valves, the flow of the water to the land can be turned off or on. The power connection for these valves can be connected to the Arduino Mega using relays to the automatically alter the power supply to the valves, causing it to either close or open.

Irrigation Water Pump: A water pump is required in order to provide enough force to move the water from the water source to the land to be irrigated. This will be achieved by connecting a water pump tp the water source and the irrigation pipes.

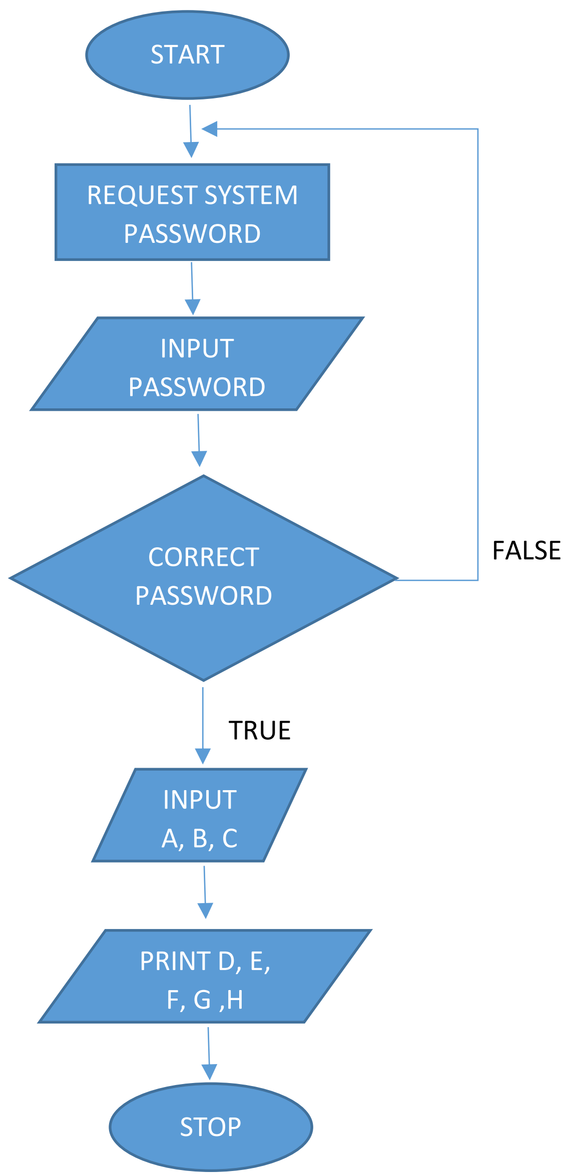
Relays: Relays are electrical switches used to establish or break an electrical connection. In this system 12V and 24V relays are used to connect and control the power supply to the irrigation pipeline valves using the Arduino Mega.

FLOWCHART AND ALGORITHM:

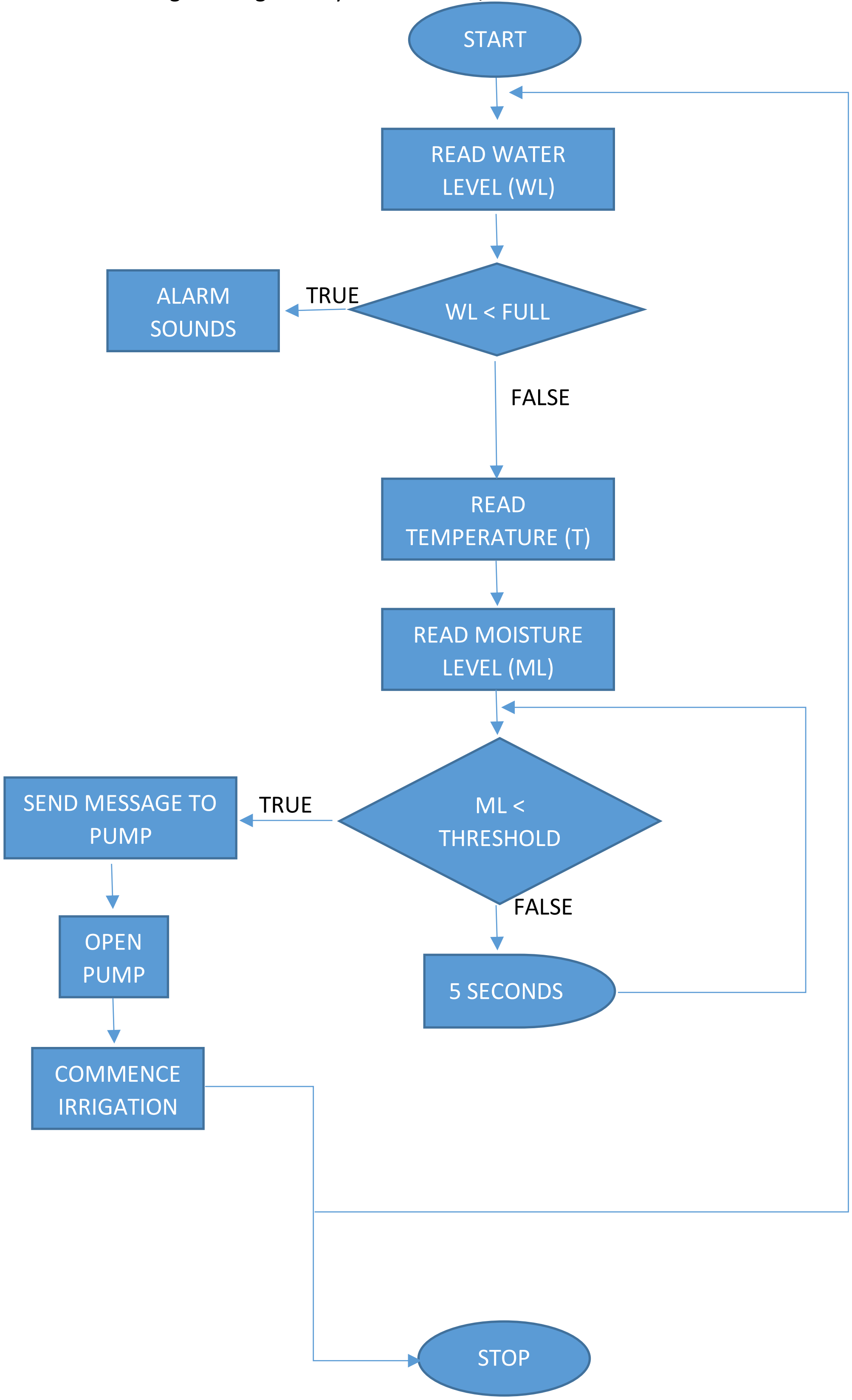
FLOWCHART:

Two flow charts were used in this project: (a) flowchart to provide the dimensions of materials to create the irrigation system; Let A = Area of land to be irrigated; B = the type of automatic irrigation required; C = Crop being cultivated in the land; D = number of irrigation blocks needed for optimum irrigation; E = number of monitoring units and control units; F = Pipeline Valves required; G = Length of irrigation pipeline needed; H = Number of outlets or sprinklers needed.

(a)



(b) flowchart causing the irrigation system to work/function as intended.



ALGORITHM:

Algorithm to decide the farm layout and materials needed to build the irrigation system

1. START
2. PRINT “INPUT PASSWORD”
3. READ PASSWORD
4. INPUT A, B, C
5. PRINT D, E, F, G
6. STOP

Algorithm to perform the irrigation process

1. START
2. READ PASSWORD
3. READ WATER LEVEL (WL)
4. IF WL < FULL
5. ALARM SOUNDS
6. ELSE
7. READ TEMPERATURE (T)
8. READ MOISTURE LEVEL (ML)
9. IF ML < THRESHOLD
10. PERFORM IRRIGATION
11. WAIT 3 SECONDS
12. GO TO LINE 4
13. ELSE
14. WAIT 5 SECONDS
15. GO TO LINE 3
16. END
17.

TOP-DOWN DESIGN APPROACH: