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AUTOMATED IRRIGATION SYSTEM USING WEATHER PREDICTION FOR EFFICIENT USAGE OF WATER RESOURCES

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ABSTRACT

Weather plays a major role in determining the overall yield of any type of cultivation. Depending on the type of plant, and the place where it is grown naturally, the water need varies, Unfortunately, the weather patterns are drastically changing and become more unpredictable in recent years due to climatic changes associated with global warming. There is a need for an automated irrigation system, which is based on the weather patterns of the particular area. The proposed system is an automated irrigation system, which determines the irrigation pattern for a particular plant on daily basis, based on the autonomous weather prediction system. The two main parameters that are considered for weather prediction are Temperature and humidity, which are used as a base in weather prediction. This system can be used to save plants from two major weather conditions, Over Rain and Summer droughts. The ultimate aim of the system is to regulate the irrigation pattern to ensure very low or no wastage of crops in natural disasters, which are inevitable in recent times.

Keywords: Automated Irrigation, Weather Prediction, Global Warming.

I. INTRODUCTION

The Weather and Climate of a particular, village or a geographical region or country is a very important key to determining the type of plants that are grown. For instance, cotton only grows in black soil and requires very little water and, grows seasonally, on the other hand, paddy grows in clay soil or alluvial soil, and needs water to be stagnant always in the fields. Rain and droughts are the two important weather conditions that affect the cultivation of many plants. In conventional systems, irrigation is controlled manually, with the knowledge of the farmers, which has been passed on for generations, but unfortunately, the weather patterns meet a drastic change, which is not normal for a particular location, year after year, the weather conditions record in a very unusual pattern, in recent years, it is very important to study these weather patterns and modify our agricultural practices accordingly. With recent technological improvements in the field of networking, Artificial intelligence, and Predictive algorithms, we can automate agriculture. The proposed system is an automated irrigation system, based on weather patterns, which helps in determining when to water the plants, and also the quantity of water that will be needed on a particular day. By monitoring the weather basis, this system determines the irrigation pattern by itself and waters the plants on a large scale. The system can be well trained to predict future droughts or floods and help in saving the crops, from either the droughts or the floods.

II. PROPOSED SYSTEM

The proposed system is designed to suit the flexible conditions that differ according to the geography of the area. The automated irrigation system, proposed in this paper, will be designed in such a way that, the user can program the working manually according to his experience or knowledge using a mobile app, or the user can choose the preset modes that are chosen by the system itself, by getting the weather data and geographical area from the on board sensors. The formerly mentioned manual mode will allow the farmer, to pre-set the time and amount of water that must be irrigated per day. The manual program has a failsafe, wherein, if there is sudden heavy rain or water empty at the irrigation reservoir, the system alerts the user, takes over the manual mode, and saves the crops from the unpredicted climatic changes, which is inevitable in the changing weather patterns due to global warming.

III. DESIGN OF THE PROPOSED SYSTEM

The system is designed and simulated using Proteus simulation software. During the implementation of the proposed system, various hardware and software components are used. In the upcoming sections, the hardware and software components used are discussed briefly.

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A. Proteus Software

Proteus Professional 8.11is used to simulate the proposed system. Proteus design suite is a professional software used to design and simulate electronic circuits in a software platform. The software is easy to use and has various advanced features, including the design and simulation of custom VLSI Chips. The proposed system is simulated using the software and discussed in this paper.

B. Components used in the system

The sensors and the other components used in the design are as follows. DHT11 sensor, which is a Humidity and Temperature sensor is used as the basic weather prediction device. This sensor is capable of providing the accurate air moisture level or in other words, the humidity of the place in real-time. This sensor is simple in construction and is available as a pre-built component in proteus software. The other sensor used is the Ultrasound sensor, which is used as a water level sensor, planned to be fitted in the water reservoir, which is the primary source of irrigation. An LCD screen is also used in the system, which shows the sensor readings in real-time. The display also helps in choosing the model using the onboard selection buttons. GPS GPRS module is used as the IoT module and the global positioning system, which is used to derive weather data from the user's mobile phone for additional weather prediction. The same module is used to notify the user regarding any weather alerts or low water alerts or any other sensor failure alerts. The central controlling device used is an ATMEGA826P microcontroller-based Arduino development board. An Electrostatic switch is used to control the water pump.

C. Block Diagram

The hardware components are represented well in the block diagram. The block diagram contains the sensors and other components, which are the functional blocks of the proposed system. Figure.1 represents the block diagram of the proposed system.

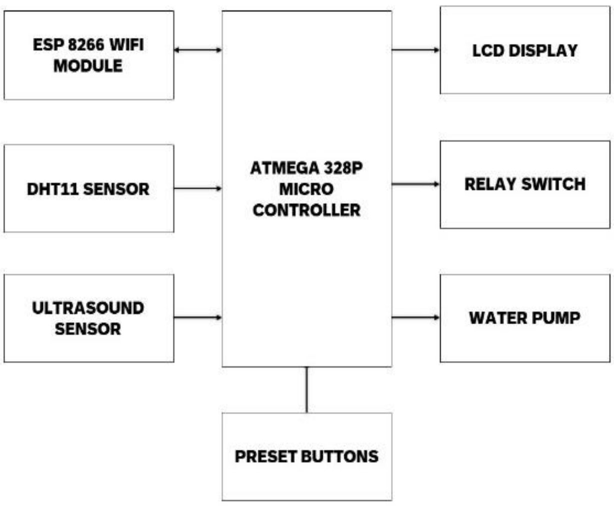

Fig 1: Block diagram of the proposed system

IV. MODELING THE SYSTEM

The development phase of the system is discussed in this section. First, the Circuit diagram is modeled and designed, followed by the building of the circuit diagram in the proteus software. Then the microcontroller is programmed according to the connections in the circuit diagram followed by the actual logic that controls the peripherals.

A. Circuit Diagram

The Circuit diagram consists of all the blocks discussed in the Section.III along with some additional components such as the power supply systems, and the circuit protection components like PN junction diodes, voltage regulators, stepdown transformer, etc. The circuit is built in such a way that it can be easily adopted when building the system physically. The entire system is designed to be operated on 5V DC. The Water pump alone functions on 220 V DC. The circuit is designed in such a way that, any further additions can be easily accommodated, without doing any major modifications. The circuit is developed manually as shown in Fig.2

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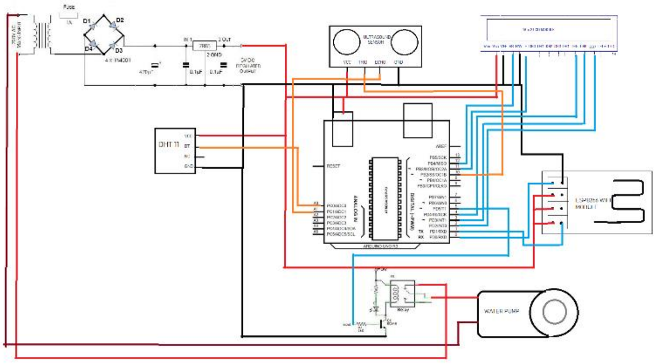

Fig 2: Circuit Diagram

B. Circuit building in proteus software

A new project folder is created and the components are added one by one in the stage area. The components are then connected, according to the circuit diagram. The Addition of components is easier in proteus software and involves searching for components in the library. The components can be repositioned or rotated to any orientation to get a legitimate diagram. Unlike the conventional circuit diagrams, the voltage source or the power source, need not be connected individually to each component through wires. Instead, the voltage sources can be copied and fixed individually, near each component. This reduces complex wirings. The circuit built using Proteus software is shown in Fig. 3.

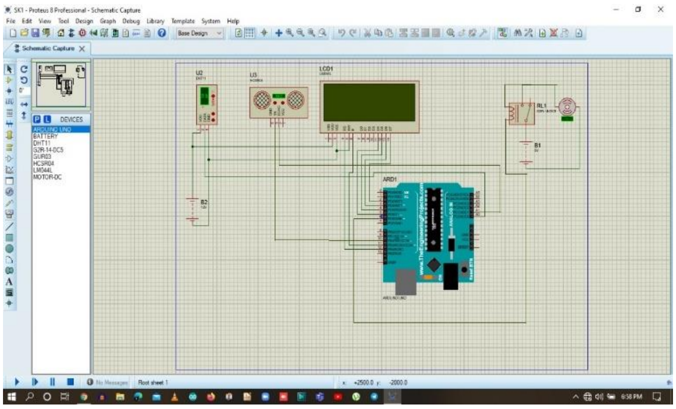

Fig 3: Circuit build-up in Proteus

C. Programming the system

The code for the micro-controller is developed using Arduino-Integrated Development Environment. Arduino is an open-source development platform, where everything is free to use and replicate. Arduino IDE Supports various development boards and has a very active community, in which developers improve the environment daily. The flexibility of Arduino IDE allows the user to create custom libraries, code blocks, etc. Fig.3 shows the code developed in Arduino IDE.

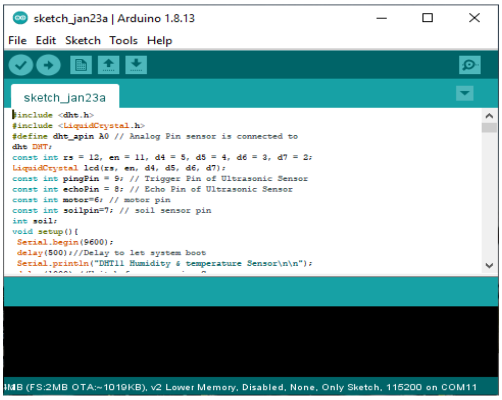

Fig 4: Code development in Arduino IDE

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V. SIMULATION AND RESULTS

The code is uploaded to the Arduino board in the proteus software using an inbuilt plugin in the Proteus design suite After uploading the code, minor changes were made in the circuitry to match the current requirements by various sensors and other components. The data transfer rate or the BAUD rate is set to 9600, which is the ideal rate. The system was simulated in both automatic and manual modes. In Automatic mode, the temperature and humidity of the DHT11 sensor were varied manually and the system is tested for the intended performance. Any changes that were needed in the threshold levels of the sensor data were updated in the code. In manual mode, the code is changed with the help of the custom-made app. The sensor readings were live read using the app which is shown in Fig.5

Fig 5: Live Sensor Readings

Necessary changes were made to the app. The third testing was done for the test cases, which will activate the fail safe mechanism.

The first Fail safe mechanism is Fail safe Mode 1. The Low water level was intentionally created in manual mode by setting the ultrasound sensor reading to 20cm, the system detected the changes in the water level, and reduced the quantity of irrigated water also sending the alert to the user through an SMS API, built within the mobile application. (SMS alert is considered more reliable in the countryside, where the broadband signal fluctuates in remote areas). The second Fail safe mechanism is Fail safe Mode 2. The sensor's humidity readings were set to 100% which indicates rain. The system acted and did not water the crops, and also alerted the user through the SMS API. The last and the critical Fail safe is the Sensor failure Fail safe. The system sent an SMS alert to the user every 30minutes to till the maintenance setup is run. Fig.6 shows the SMS alerts received during the simulation phase.

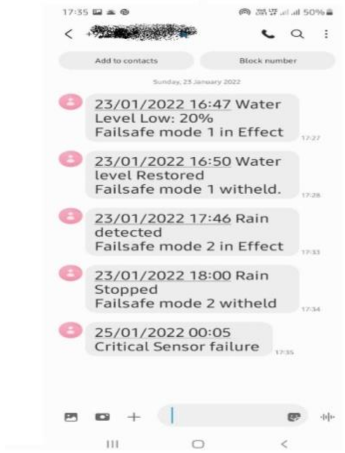

Fig 6: Fail safe alerts received in user's mobile phone

VI. CONCLUSION

The Automated irrigation system is built using Proteus Design Suite and various scenarios were tested during the simulation of the system. The Manual and Automatic modes were simulated, and the water pump was activated and deactivated, in the designed time intervals. The various fail safe modes were also tested by creating fake scenarios by altering the sensor readings, and they were alerted promptly with the time and failure cause, and model number. The critical sensor failure was also simulated by removing the power supply to the sensor and the alert was sent to the user every 30 minutes, till the sensor's function was restored.

VII. FUTURE SCOPE

The system can be improved by adding the weather prediction from weather satellites, and other such sources, which detects the upcoming events very early compared to the local sensors. Another such improvement is the addition of other sensors like cameras, and flame sensors to detect animal movements and wildfires and deploy countermeasures like sprinklers and alert the farmers accordingly. This system can also be modified and deployed in advanced farming techniques like inter cropping, hydroponics, aquaculture, etc.

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