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Automatic Irrigation Systems for Efficient usage of Water using Embedded Control Systems

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Abstract. Agriculture, the main livelihood of millions depends mostly on the regular supply of water. With fast depleting fresh water resources the need of the hour is effective utilization of water. Till recently farmers have been irrigating using water when and wherever needed by manually switching on or off the motor pumps. This required constant monitoring of the water supply and also there were problems of power supply not being available during day times. With the introduction of modern techniques like drip water irrigation and even fertilizer supply being done along with water, we needed automation techniques. Remote monitoring and control have been introduced due to non-availability of cheap human resources. Now it is being introduced in all places for efficient utilization of water.
Keywords: Automation, Embedded, Water, Pumps, Fertilizer

1. Introduction

Water is an essential for agriculture purpose and has a significant impact on yield and quality of crops, as scarcity of water become the global problem, utilization of it during irrigation becomes the priority factor in current scenario. Increase in population and demand of food results in rapid growth in food production technology. Automation of agriculture process is the need of the hour for effective utilization of water resources for increasing the economic yield and economic viability. Instead of the manual supply of water, usage of automation results in increased yield and effective usage of water. We are proposing the use of Embedded control systems for automation. We are proposing the use of Sensors to check the humidity of the soil for switching on the motor when required.

2. Literature Survey

The designed system obtains the temperature, air humidity, sunlight density and CO_2 density with automatic precision irrigation system in the modern greenhouse environment. The results of the system in increase of transpiration speed of crops [1].A three power line carrier communications technologies was designed and implemented during 1995 using distributed control network for agriculture management [2].A design was proposed for low-cost multi-mode control for an irrigation system based on PC. The climatic conditions and soil moisture is monitored by Microprocessor based system [3].

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The proposed model was implemented during 2008 as one of the Olympic Games facilities projects, which monitors the soil water content and on various modes of irrigation automatic control [4].The proposed system describes on automatic water saving irrigation based on solar energy in achieving control purposes by moisture control monitoring techniques. The system design takes into the parameters such as vegetation height and water flow [5].The proposed system discusses on variable rate automatic microcontroller based irrigation system based on solar. Hardware implementation of the proposed design was discussed [6].

The proposed system describes on monitoring moisture level and water flow using sensors. The system is based on Arduino microcontroller and communication established using Zigbee protocol. The moisture level and motor status is sent to farmer's mobile [7].Wireless Sensor Nodes plays a major role in automated water irrigation system and the farmer have control over the water flow in the field and directs it on need [8].Disruptive technologies such as Internet of Things and Big data plays a vital role in modern agriculture in current scenario. The proposed system predicts and forecast the water requirement of crops on different seasons resulting in saving water and fertilizer [9].

The proposed system describes the automatic irrigation system based on LoRa technology which provides significant advantages in terms of power consumption and transmission range for automatic irrigation system. The sensor nodes collects the parameters of soil humidity, temperature and moisture [10].The proposed design describes about automated water irrigation based on Machine learning with LoRa P2P networks for greenhouse organic crops. The design calculate the amount of water combined with environment data such as air temperature/humidity, soil temperature/humidity and light intensity [11].Figure 1 displays the attractive opportunities in smart irrigation market. It is estimated to be 1 billion USD in 2020 and it is estimated to reach 2.1 billion USD by 2025.

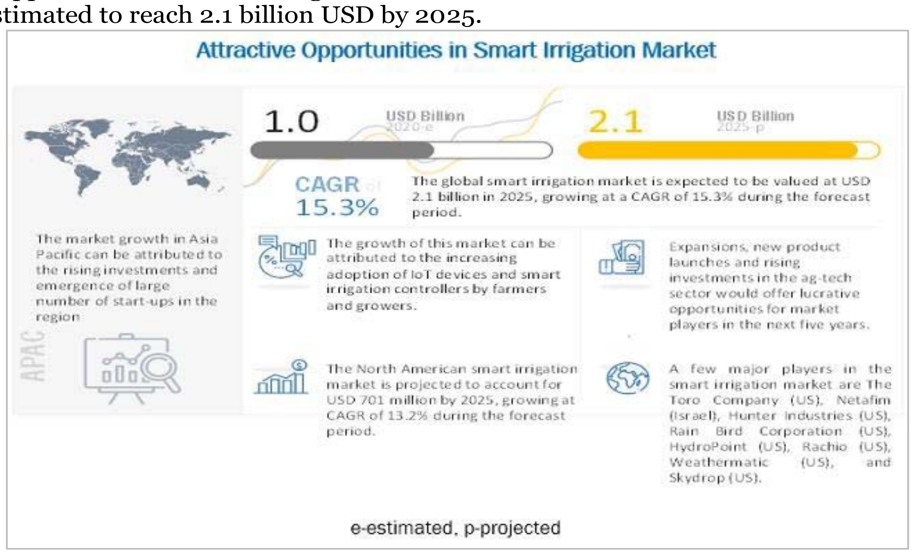

Figure 1. Attractive opportunities in Smart irrigation market

3. Objective

Increase in human population and depletion of world resources are to be noticed on priority. For effective utilization of existing resources modernization of irrigation systems to be the solution. Environmental parameters are to be monitored continuously for decision making on the problem statement.aking of the proposed design describes about automated water irrigation based on Machine. The proposed system saves water and energy also improve the productivity in the farms.Figure 2 shows the automatic irrigation system.

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Figure 2. Automatic irrigation system

4. System Design

The proposed system is shown in the Figure 3. It consists of an Arduino board which is used to interface different sensors including ultrasonic sensor, light ambient sensor, humidity sensor, temperature sensor and soil moisture sensor. It also controls a light, solenoid valve, water sprinkler and a cooling fan. The different sensors are used to measure different parameters for switching ON or OFF the relevant motor or fan or light as the case may be. We would be discussing the different components used in the forthcoming sections.

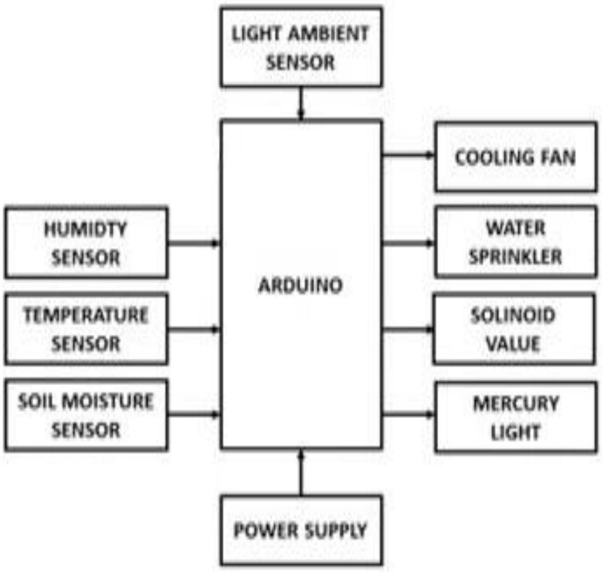

Figure 3. Block diagram

5. Arduino Uno Development Board

The Arduino UNO is based on the Microchip ATmega328P microcontroller which has been developed by Arduino CC. It is an open source microcontroller board developed for free use by developers and has been widely used in many applications. The board has 14 digital pins and 6 analog pins. The board can be programmed using Arduino Integrated Development Environment. The board requires an external 9 volts battery or can be powered using a USB cable. Figure 4 displays the Arduino Uno development board.

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Figure 4. Arduino Uno Development Board

6. Sensors Used

The system uses a light ambient sensor, humidity sensor, soil moisture sensor and temperature sensor. The light ambient sensor is used to measure the ambient light present in the field. Light is an essential ingredient for growth of plants. With sufficient light provided the growth rate has been proved to be increasing. Particularly during cloudy days it has been useful. Also during winter season when the daylight is available for less duration artificial light can be provided to increase the growth and the yield. The sensor senses the ambient light. When the ambient light is less, then an electrical light can be switched to provide artificial light. In our prototype we have used a simple bulb which can be modified to more number of bulbs of sufficient ratings and required type for providing daylight like ambience. Figure 5 displays the light ambient sensor.

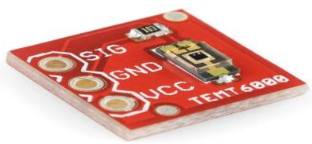

Figure 5. Light Ambient Sensor

The system uses a light ambient sensor, humidity sensor, soil moisture sensor and temperature sensor. The light ambient sensor is used to measure the ambient light present in the field. Light is an essential ingredient for growth of plants. With sufficient light provided the growth rate has been proved to be increasing. Particularly during cloudy days it has been useful. Also during winter season when the daylight is available for less duration artificial light can be provided to increase the growth and the yield. The sensor senses the ambient light. When the ambient light is less, then an electrical light can be switched to provide artificial light. In our prototype we have used a simple bulb which can be modified to more number of bulbs of sufficient ratings and required type for providing daylight like ambience. Figure 6 displays the DTH11 Humidity sensor.

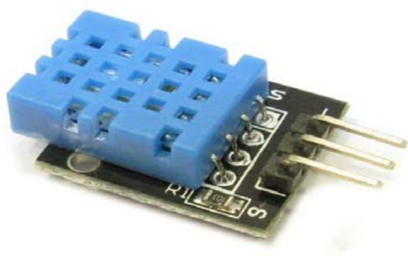

Figure 6. DHT11 Humidity sensor

A humidity sensor is used to measure both the moisture and air temperature. Humidity sensors work on the principle of detecting changes that result in change in electrical currents or

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temperature in the air. The three types of sensors, namely capacitive, thermal and resistive, monitor the changes that happen in the atmosphere for calculating the air humidity. In our system we use DHT 11, a temperature and humidity sensor. it used to calculate the humidity so that the water pump can be switched on during dry conditions and high ambient temperature. Figure 7 displays the soil moisture sensor.

Figure 7. Soil Moisture Sensor

Soil moisture is also an important factor to be considered for increasing the yield. It should be in the optimum level for the plants to absorb the water content from the soil through the roots. When the soil becomes dry it is an indication for the water to be supplied. Also more water might lead to damage of the crops. The motor should be switched on or off automatically without the need for human intervention, in order to save precious time and labor. Also in cases of large fields, one area might not have received sufficient water supply.

With the usage of water sprinklers and control of valves the required area alone can be watered. In the conventional method water supply originates from the water source and reaches the end areas. In this case the land near the source gets more than the required water supply which is wastage of precious water supply. With the advent of water sprinklers the water wastage has been reduced. But we need to have control valves to supply water only to areas that need water supply based on the measurements read by the soil moisture sensors placed in different areas of the field.

7. Results and Discussions

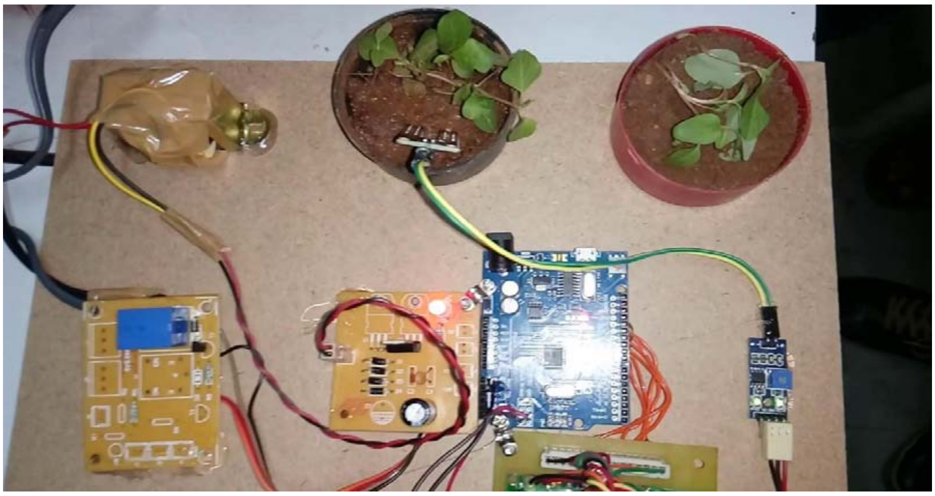

Figure 8. Automatic irrigation system prototype

Figure 8 shows the prototype of automatic irrigation system. Based on the moisture of the soil, water will be sprinkled to the field thus the effective utilization of water is performed. Also, the automatic irrigation system overcomes the tedious process in manual irrigation system and also prevents soil erosion and nutrient runoff due to excessive water flow in field. The sensors plays the major role in automatic irrigation system.

8. Conclusion

With the use of different sensors as mentioned we are proposing a system that helps in efficient usage of precious natural resources and also in increasing the overall yield of the crops. The proposed system can be extended to large fields by increasing the sensors and having motors, light supplies at different places of the large fields. The major factors influencing the growth of the smart irrigation market include increasing demand for food production, increasing government initiatives to boost water management and automatic scheduling of irrigation, resulting to reduced labor costs.

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