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Augmented Reality for Irrigation and Soil Moisture Detection

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Abstract

Everything starts with water as its fundamental material. Water waste results from overconsumption, and it happens in agricultural areas as well. We suggest augmented reality for soil moisture measurement and irrigation to solve this issue. The farmer may irrigate the field with this idea and save water. Using augmented reality glasses, the soil 's moisture content is identified and visualized. The newest technology in the current world is augmented reality. It is described as a blend of actual and virtual picture projection, interaction with real-time appearance, and the appearance of 3D figures of them. Technological progress allows more and more sensors to be manufactured on a microscopic scale as microsensors using MEMS (microelectromechanical systems) technology. In most cases, a microsensor reaches a significantly faster measurement time and higher sensitivity compared with macroscopic approaches. Due to the increasing demand for rapid, affordable and reliable information in today's world, disposable sensors low-cost and easy-to-use devices for short-term monitoring or single-shot measurements have recently gained growing importance. Using this class of sensors, critical analytical information can be obtained by anyone, anywhere and at any time, without the need for recalibration and worrying about contamination.

Keywords: Microcontroller, water, sensors, automated watering system, microelectromechanical systems (MEMS) technology, Global System for Mobile Communications (GSM) module

INTRODUCTION

The need for food is constantly increasing as food production has improved via technological advancements. Agriculture is the primary economic activity in the majority of countries. Because of their reliance on rainfall, most countries are unable to make appropriate use of their crops. In general, all farmers regulate the electric motors by visiting the fields and then checking the soil, crop, and weather conditions. All irrigation systems are powered by electricity and are regulated using the ON/OFF mechanism. Sometimes the field is flooded with extra water and at other times the fields become dry due to a shortage of electricity and mismanagement in manual managing systems.

Here, we report on automatic irrigation systems to avoid manual control. These systems are often made to maintain the right amount of water in the fields so that plants can develop fields so that plants can develop throughout the year. Augmented reality is expected to gain popularity in the upcoming years due to its use in water-saving irrigation and automation [1]. Using the GSM (Global System for

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Mobile Communications) module, the mobile device receives a message telling it to turn the pump on and off.

A few years ago, the majority of irrigation models were powered by electricity, and the hardware rate was set accordingly. The hardware models are made with more costly devices because the hardware is expensive. The high cost of hardware prevents the average farmer from purchasing and using it. Farmers only use the kinds of models on their farms for government- or private-funded experiments or demonstrations.

On the other hand, the variable rate automated regulating approach method enhances the irrigation system, lowers overall costs, and boosts crop productivity. As a result, farmers are designing irrigation systems with variable rate automated operation and low cost [2].

Crop cultivation is a difficult work for farmers since it depends on a number of factors, including soil conditions, moisture content, pest problems, weather, and temperature. The Water Commission claims that approximately 70% of water is used for agriculture, resulting in water waste in the field where mechanical irrigation is employed. With the aid of the soil's moisture level indicator, automatic irrigation is being carried out. Augmented reality is used to display the temperature, and finite element analysis can also be used to determine it [3, 4]. The purpose of automatic irrigation is to save the farmer from having to manually turn on and off the pump. The mobile device receives a message telling the farmer to turn the pump on and off.

In this study, we present an automated irrigation system that uses augmented reality. These sensors will gather data on the field's water level, which the GSM module will then send to the farmer by text message as [5, 6]. The farmer can use the cell phone to turn the motor on and off based on the water level. Only the microcontroller determines whether the motor should turn on or off after the moisture sensor has determined the soil's moisture level.

The suggested model's block diagram is shown in Figure 1 in the second section, while the third section provides a detailed explanation of the circuit components. This section also shows the hardware implementation of the suggested model.

PROPOSED MODEL

The proposed circuit model's full block diagram is displayed in Figure 1. We must install a variety of sensors across the area in order to cover several hectares. The authorized person's mobile phone will receive a message from the sensor, which measures the field's moisture content, temperature, and water

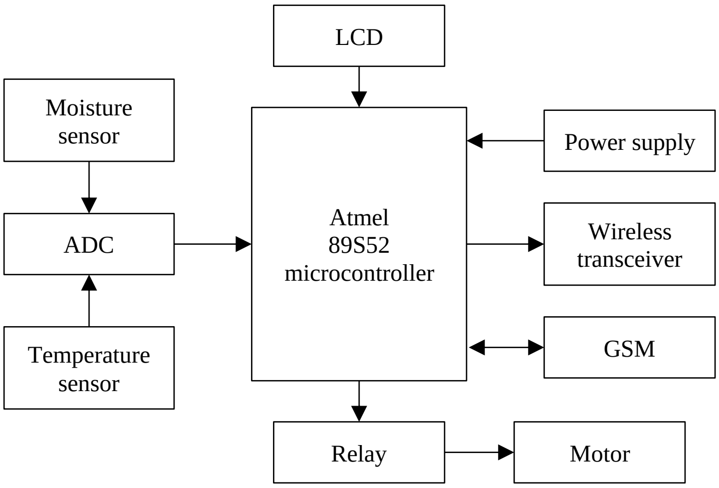

Figure 1. Block diagram of the proposed circuit model.

level, informing them of the irrigation situation. The suggested system is powered by AC power, though solar power may also be used [7]. AC power is interfaced with sensors, microcontroller, wireless transceiver, relay, GSM, and motor.

PROPOSED MODEL DESCRIPTION

Circuit Description of the Proposed Model

A step-down transformer receives the single-phase power supply and reduces the voltage to 12 V AC. This 12 V AC is transformed to 12 V DC using a bridge rectifier, and then it is controlled to 5 V using a voltage regulator so that the microcontroller can function. The soil resistivity sensor measures the soil's state and compares it to a 5 V threshold voltage. An ADC (analog to digital converter) is responsible for this process. Here, we utilize almost four sensors around the field [8–10]. The ADC immediately transmits the logic signal 1 to the microcontroller when condition is less than the reference voltage, or 5 V. This indicates that the soil is dry. When signal 1 is sent to the microcontroller it automatically triggers the motor circuit to pump water.

The soil is regarded as being in a dry condition if its pH is higher than 5. The four sensors will provide the message. The motor is then prompted to pump water into the field after the ADC provides the microcontroller the logic signal 0 [11]. This shuts off the motor driver circuit. We use the LCD display to depict the soil moisture level and the pump's status. The pump automatically stops when every sensor reaches the threshold level; if not, water is pumped until every sensor reaches the threshold level. The breadboard has a transmitter, and the augmented glass has a receiver. The temperature level and pump status are displayed by the device that receives the signal.

The farmer receives messages via GSM regarding the condition of the pump and the soil's moisture content. These are put in place to prevent the need for repeated field visits. This is then connected via a mobile device, making it an easy-to-use one.

Compared to linear temperature sensors calibrated in Kelvin, it has the advantage that the user can obtain the convenient Centigrade scaling without having to subtract a huge constant voltage from the output. Trimming and water level calibration sure that the equipment is inexpensive. Figure 2 illustrates the LM35 temperature sensor, known for its extremely low output impedance, linear response, and high-precision intrinsic calibration. These features enable seamless integration with readout or control circuits, ensuring accurate and reliable temperature measurements.

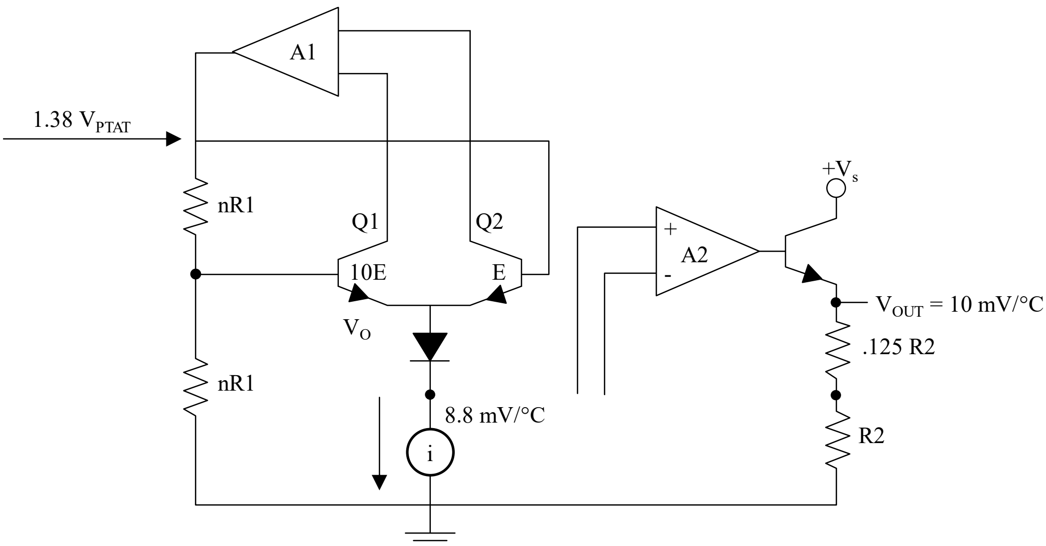

Figure 2. Circuit diagram for LMM35 temperature sensor.

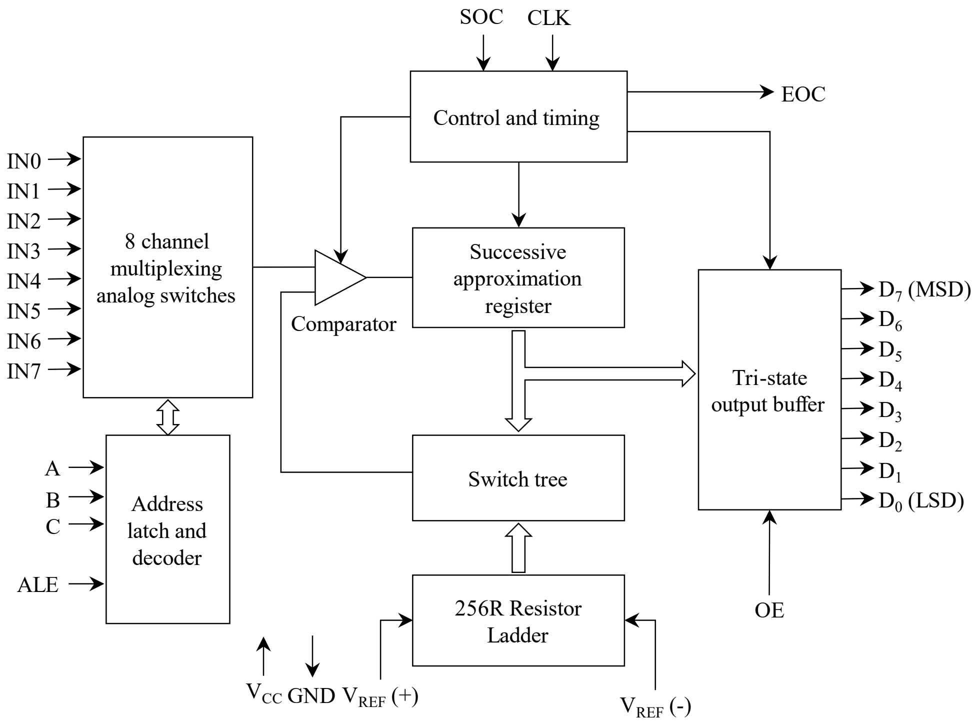

Figure 3. Block diagram of ADC0808/0809.

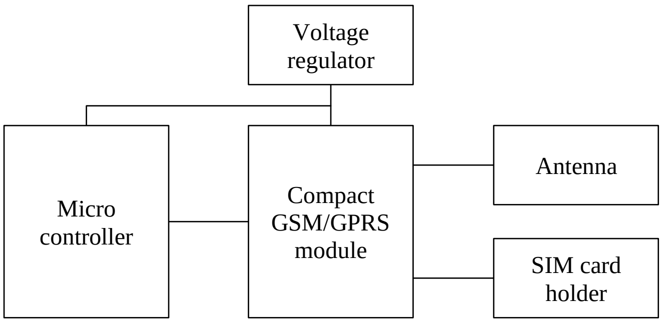

Figure 4. Block diagram of GSM modem.

Figure 3 shows the block diagram of the ADC. Because the microcontroller receives the signal in the form of binary digits that are equal to 0 and 1, this is utilized to convert the analog signal to a digital signal. The pump stops if the microcontroller receives a signal of 0. If the micro-controller receives a signal of 1, the pump begins to pump and pushes water throughout the field.

Using a successive approximation register, the digital code for the input value is iterated eight times. Specific Absorption Rate (SAR) causes the reset on the START pulse's positive edge, and the conversion process begins on the pulse's falling edge. The conversion procedure will stop when a new START pulse is received. The end-of-conversion (EOC) will go low between 0 and 8 clock pulses following the positive edge of the START pulse. This ADC is used to tie the output to the START input, creating a continuous conversion mode. When power is turned on in this situation, an external START pulse should be applied.

The farmer can receive messages regarding the condition of the pump and the soil's moisture content thanks to the GSM modem. in order for the farmer to prepare ahead and make things easier for themselves. We have an antenna for the transmission, and the sim is inserted into the sim holder so that messages can be sent. Figure 4 displays the GSM module block diagram.

Hardware Implementation of the Proposed Model

The main source for the step-down process that turns 230 V into 12 V AC is a transformer. After the bridge rectifier has converted the 5 V AC to 5 V DC, the lower power is supplied to the circuit board's IC and microcontroller. The relay card next to the circuit board receives the supply, followed by the GSM module next to the circuit board and the ZigBee across from the relay card. The micro controller is connected to the soil resistivity sensor, and the circuit board’s LCD display relays the signal to the microcontroller, which is used to regulate the pump. When the board is turned on, the pump receives the supply and begins irrigating the field before retrieving the sensor's data. Figure 5 depicts the Zigbee model's operational circuit.

The microcontroller receives the information, which then travels to the zig bee and the GSM module, which uses wireless transmission to transmit messages to the mobile device and the augmented glass. Both the L1 and L2 LEDs flicker bridge while the board is on the relay card 'syndication’, and then the pump begins irrigating the field. The GSM model's functioning circuit is depicted in Figure 6.

The pump is turned off once it receives a signal from the sensor regarding the soil's moisture content and sends it to the microcontroller. After passing via a converter, the sensor's signal is converted into a binary format and supplied to the controller. The relay card receives a signal from the sensor indicating that the pump has begun to irrigate if it receives zero as an input signal from the micro controller. At that point, the L2 LED turns on.

The relay operates in this way when the board is turned on and off. The L1 LED begins to glow to show that the water level has been reached, and the pump is off if the sensor delivers one as an input signal to the controller. The relay is essential for turning the pump on and off. In this case, we are employing a channel relay system that manages single motors. Through its connection to the micro controller, this relay transmits data to the GSM module and the ZigBee.

Figure 7 shows how the suggested model is fully implemented, including how the controller, relay, and GSM model operate. Figure 8 displays the whole augmented reality model, including all of the temperature and moisture data that will be shown in the augmented reality glass.

Flow Diagram of the Proposed Model

Using a 12-V power supply that has been step-down with the aid of a step-down transformer, we are starting the system. Initially, the data is obtained from the sensor positioned at each of the fields' four corners. The threshold voltage (5 V) is used by the sensor to determine the water level in the field. After then, it begins to assess the sensor's condition. If the water level is equal to the threshold voltage level when the sensor detects it, the signal is transferred to the ADC, which transforms it into binary form and delivers it to the microcontroller.

Figure 5. Working circuit of ZigBee model.

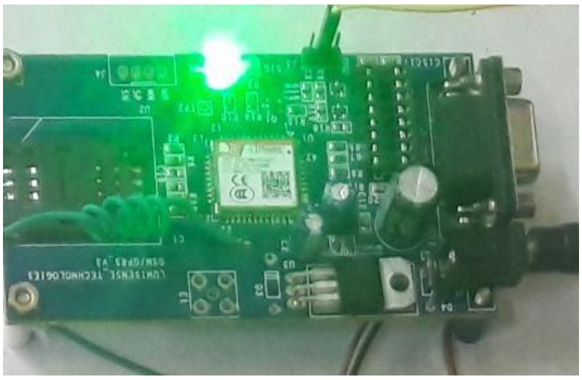

Figure 6. Working circuit of GSM model.

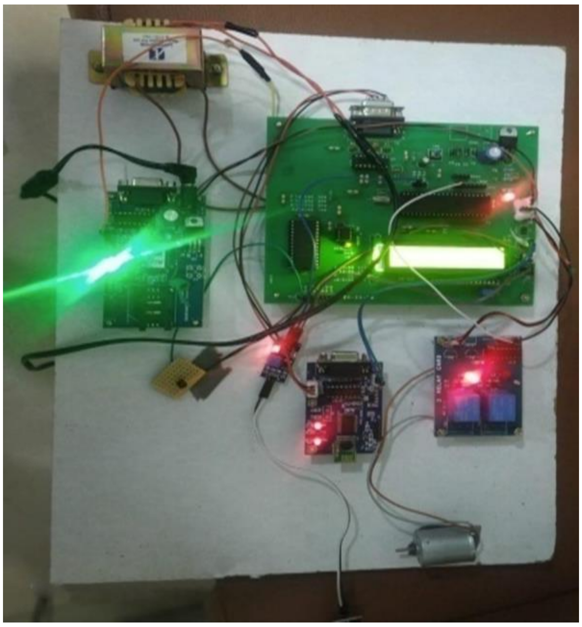

Figure 7. A complete implementation of the proposed model.

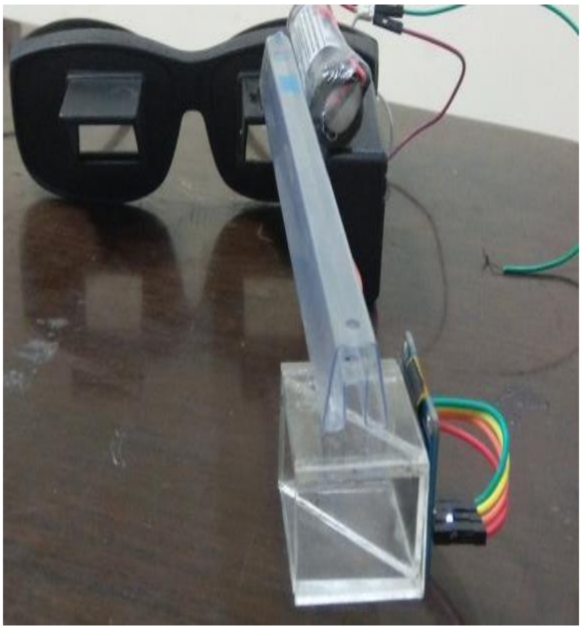

Figure 8. Complete setup of augmented reality glass.

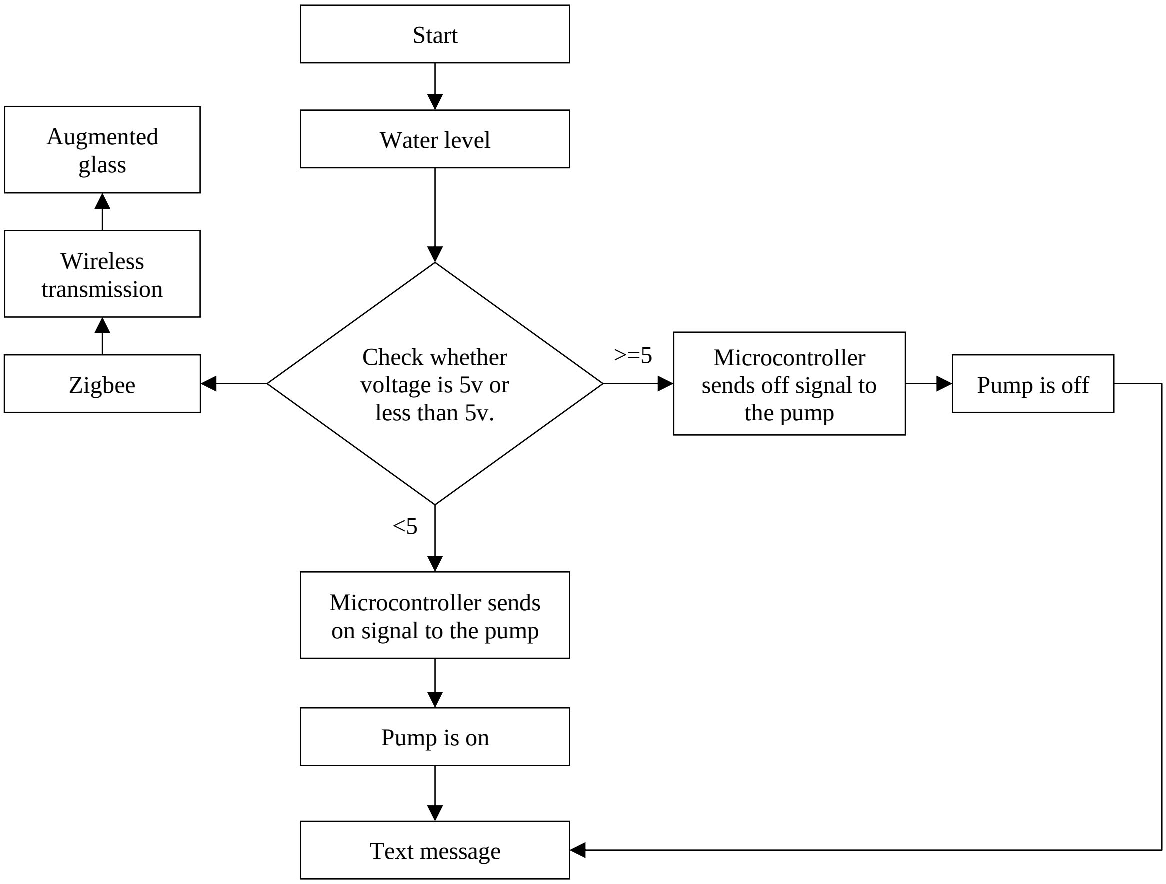

Figure 9. Flow diagram of the proposed model.

The sensor now checks the water level; if it is equal to the threshold voltage, the ADC sends a signal of 1 to the microcontroller. The irrigation operation is then stopped when the microcontroller signals the pump. When the pump receives an off signal, it automatically creates a text message and sends it to the farmer's mobile device over GSM. Following another text message, this ADC signals the ZigBee to transmit the message to the augmented glass. We have a receiver on top of the augmented glass that gets the message from the ZigBee wireless transmitter.

The sensor transmits the signal to the ADC, which transforms it into a binary signal, if it detects that the water level is below the threshold voltage. The microcontroller in this instance gets the input signal as 0, indicating that the field's water level is extremely low. The pump then begins irrigating the field until the water level reaches the threshold voltage level after receiving a signal from it.

The farmer's mobile device receives a text message that provides information on the field's temperature and the pump's condition. The GSM module is responsible for sending this text message. A wireless transmitter and ZigBee are used to provide data, which includes the field temperature and pump status, to the augmented glass. The receiver on the augmented glass is used to receiving this. As seen in Figure 9, this procedure is repeated since it is continuously monitored.

CONCLUSION

Since food is the primary source of sustenance for humans and water is essential to daily life, we must protect it for farmers since agriculture is the foundation of our nation. Farmers will benefit greatly from this project since it will allow them to employ water irrigation calculations for the field and save extra water thanks to sensors placed on the field's four sides. Then, by incorporating augmented glass, we transform the conventional irrigation technique into a modern technology approach, allowing farmers to follow the latest developments in their field. This project lessens the amount of human labor and the frequency of field visits by farmers. Everybody has a phone, which is easy to use and convenient for farmers. The glass is more portable, allowing farmers to view the condition of their fields from within 50 to 100 meters of their location. Introducing farmers to the world of technology will be quite helpful.

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