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IoT-Based Low-Cost Automated Irrigation System for Smart Farming

Tajim Md. Niamat Ullah Akhund, Nishat Tasnim Newaz, Zahura Zaman, Atia Sultana, Alistair Barros, and Md Whaiduzzaman

Abstract In this research, we present a low-cost intelligent irrigation system for farming. Nowadays, farming is shifted to automated and remote monitoring and management systems integrated with Cloud, Fog, and IoT networks. Our developed prototype can measure water level, temperature, and humidity with a hardware sensor and micro-controller unit. We use different sensors to take different readings and values to decide to turn on or off the motor. We provide essential algorithm and flowchart to explain the system. Our IoT-application-based automated developed system makes an automated system for irrigation and provides notification via mobile SMS to inform us of the irrigation field's details remotely.

Keywords IoT · Smart farming · Smart irrigation · SMS notification · SIM Module

1 Introduction

Agriculture is still one of the main GDP growth and national number one activities in many countries. Nowadays significant amount of people depend on farming and agriculture worldwide Therefore, farming and agriculture have a strong impact on our food chain and economic growth and activities nationally and internationally. Thus, we are still largely depend on the farming and agriculture for essential food supply and trade. This work will result a system which will help farmers is agriculture. However, in many countries, worldwide agriculture and farming related tasks are not fully automated. Our farmers are suffering from various problem. Although they

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are working hard but not getting desired outcome without automation. This scenario motivated us to make this research project. This work wants to meet the following objectives:

1. Collecting data of temperature, humidity and water level from farm and show those data to a monitor.
2. Giving notification via Mobile SMS.
3. Making intelligent decision and controlling the irrigation system based on the collected data.

This work will result in an IoT based system which will prevent electricity waste and water wastage. Farmers will be notified via SMS too. But Sensors only work within a specific area and sending SMS notification is not free of cost. Sensors and MCUs life time are also not very large. These are some challenges to implement this project. In the paper organization, first section is containing introduction and objectives of this work. The second section is containing the background study. Methodology and system model are mentioned in section three. The results and output are shown in the fourth section. The last section is containing the conclusion and future works.

2 Literature Review

Smart cultivation is the most important harvest in the sector of agriculture and with the help of this. Nowadays, thanks to the modernity of agriculture, farmers are able to grow rice thrice annually. Poultry farm automation [7], paddy cultivation [11], fruits cultivation [4], and hotel management [6] are doing well with the help of IoT. Remote sensing [3], remote Monitoring [5], virus affected people management [1], neuro-patient management [2] are blessed with IoT nowadays. Electronic voting [17] and bio-metric security [18] are also using IoT. We can collect data with robot from remote place by using IoT [18]. Farmers would be motivated to grow jute in order to expand the demand for these jute crops, revitalize the jute mills, raise prices, boost the advertising of jute [14]. In agricultural development, many new technologies are there in the cycle and with the improvement of these new technologies the smart farming system gone beyond description enhancement [6]. Agriculture and agricultural science are progressing at a rapid rate thanks to this IoT method [16]. To the point that there is no simpler way or adopt better of a product at a reduced amount, people still sought to do further experiments [20]. Around 75-77% of the population in Bangladesh are reliant on farming [20]. The new web creation is the IoT that assemble the usefulness of a machine like camera sensors [15], RFID smartphones, and wearable devices, etc., used by so many companies for their own need [22]. Agribusiness adds to the natural maintainability needed to blast crop yields and reduce costs [12]. Agri-cloud that increments rural creation and the accessibility of data related to bombed research activities, the effect of doing this could spare time and worth creation discussion less confounded and quicker [9]. The higher the popu-

lace in that nation, the higher the need to utilize the IoT framework [8]. Cloud based systems can make a secure [10] way to monitor various data and e-governance application [21]. IoT-based education can help people [19] with mobile cloud computing [23]. Cloud based can also trace virus community transmission [24].

3 Methodology and System Model

3.1 Requirements

We several hardware, and software part C++ programming language and Arduino IDE. We have used low-cost micro-controller unit Arduino UNO Revision 3. Moisture sensor and Water level sensors are used to sense the moister and Water level of the soil and send it to Arduino. DHT11 temperature and humidity sensor is used to sense the temperature and humidity. A LCD monitor, a SIM Module sim 800 is used to send the collected data and motor state to a mobile as notification. A relay module is used to control the high-voltage motor with only 5 volts provided from Arduino.

3.2 Algorithm

The system sense the data about temperature, humidity and water level from field. With the value, the system will automatically turn on and off the water pump. The system can show the data and notifications in a LCD monitor. If a condition fulfilled then the system can send SMS notification to a selected mobile phone. The algorithm is as follows:

Step 1: Power on.
Step 2: Temperature, humidity, water level data sensed.
Step 3: Show the data to a LCD monitor.
Step 4: Control the relay and motor by following the sensor data.
Step 5: if (water $<$ threshold value) Motor on.
else Motor off.
Step 6: Send SMS to a mobile number if provided condition is met.
Step 7: Stop.

3.3 System Model

The flow of system is discussed in Fig. 1. The system sense the data about temperature, humidity and water level from field. The system can show the data and notifications in a LCD monitor. With the value the system will automatically turn on and off the

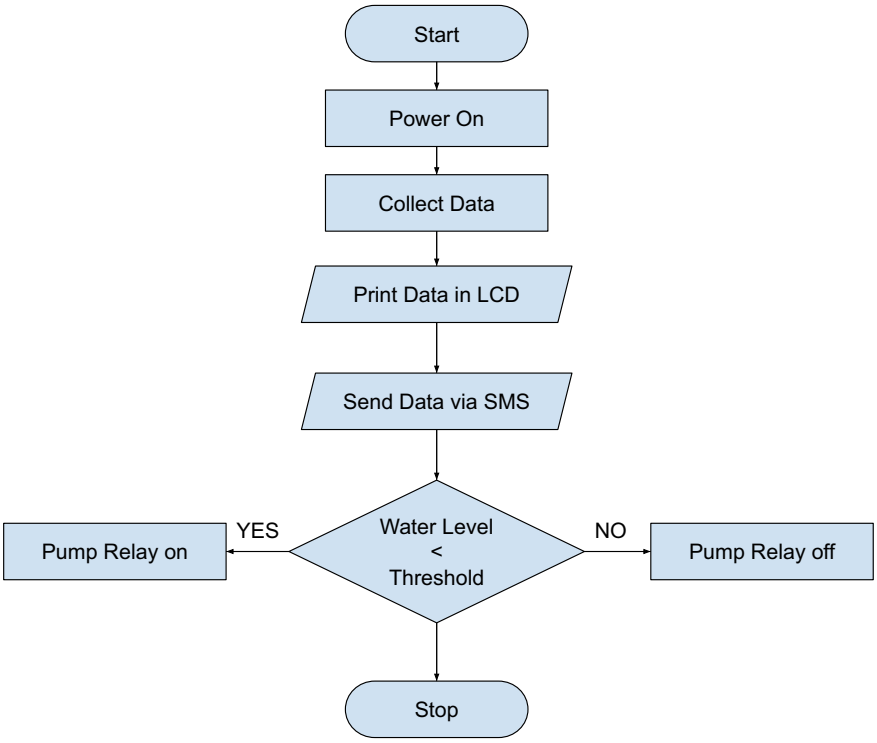

Fig. 1 System flow chart

water pump. The system sense the data with sensor for temperature, humidity and water level from field. With the value of the sensor the system will automatically turn of and off the water pump by following the algorithm. In a LCD monitor, the system can show the data and notifications.

3.4 Conceptual Circuit Diagram

The prototype 1 is made without SIM module is illustrated in Fig. 2. In this module, the project is made with SIM module SIM800L, Water Level Sensor, DHT11 Temperature and Humidity Sensor, Relay module, Arduino Micro-controller, LCD Module, and Motor. SIM module SIM800L, Water Level Sensor, DHT11 Temperature and Humidity Sensor, Relay module are connected with Arduino Micro-controller. Arduino sense the data and show the collected data and motor state in LCD Module. Arduino sends the data to relay module to on and off it. Relay module turn on and off the motor.

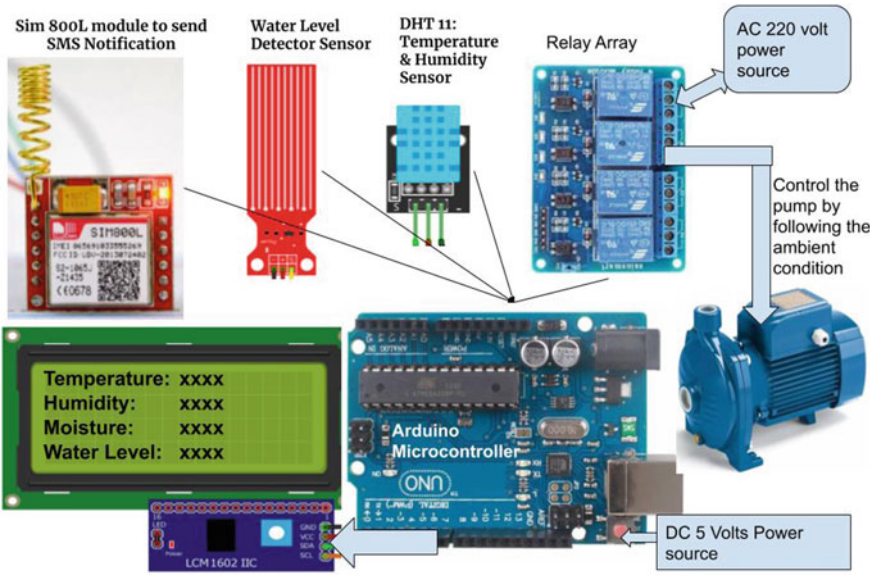

Fig. 2 Conceptual circuit diagram with SIM module

4 Results

In this section, we discuss the output of our designed prototype and its significant.

4.1 Prototype Output

The final prototype made for this project is illustrated in Fig. 3. Here, we can see the 2 power supply were used. One is for MCU unit, and another is for running the Water pump. The SIM800L module is situated in the bottom side with a SIM. Water level sensor is inserted in a small bowl to test. The 20 × 4 LCD monitor is showing data and situated on the top. Relay module is situated beside the small pump. In prototype, we used small pump but in final real-time project we can use big field pumps. The MCU and Power supply and power converter is situated in the middle. An analog switch is also set upped to start on the condition for sending the message. Finally, it worked nicely. We got the SMS notification also. The SMS notification is shown in Fig. 4. The SMS notification notifies about the temperature, water level and humidity of field and also notify about the Pump state On or Off. It worked successfully.

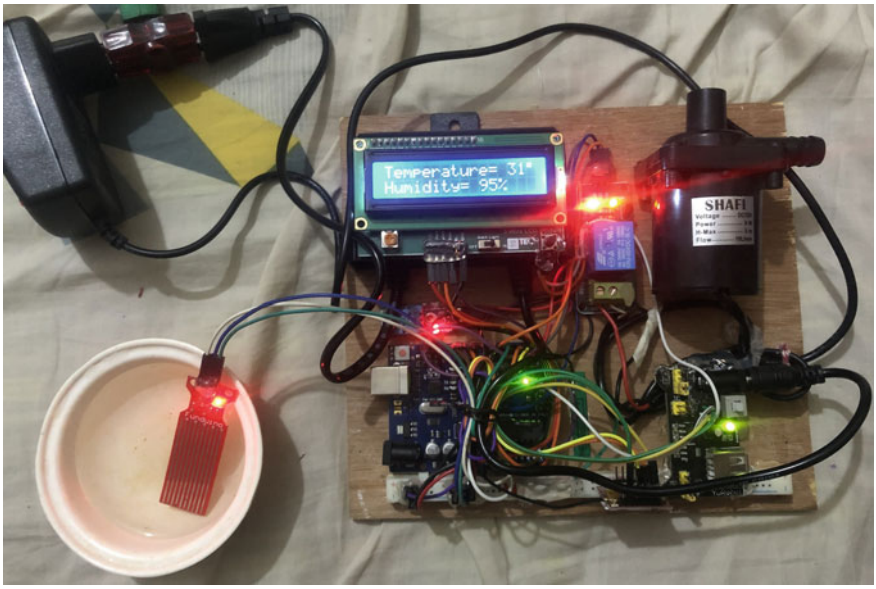

Fig. 3 Final prototype with SIM module

4.2 Preliminary Results

From the result, we received successful output which are mentioned is Fig. 5.
In this research project, we have tested our implemented prototype around 1000 times. The features obtained from this project's final prototype are as follows:

1. System can make Automatically motor start and off by following the threshold value of sensor data.
2. System can measure Moisture, Water level, Temperature, and Humidity.
3. Can Show the measured data on LCD.
4. The system can send Mobile SMS Notification about all state.

Our developed system costs us only around 20 USD with all of these features where as in marketplace amazon and others developed systems costs more than 50 USD without having the similar facilities such as SMS notification [13].

5 Conclusion

This work results a practical system for irrigation which is better than some other systems available in market. The developed system can monitor the water level, humidity and temperature of the field and not only show the data in a monitor but also sends the data to a mobile phone with SMS. Farmers do not need to use any smart

Fig. 4 SMS notification in mobile

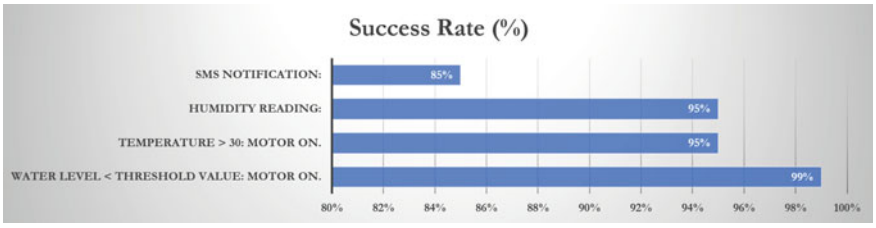

Fig. 5 Success rate of various features

phone or internet. They can monitor their field with any feature phone via mobile SMS. The system can control the water pump turning on and off automatically by considering the collected data and ambient environment. In future, this system will detect the problem in the irrigation and agricultural field with the help of machine learning and will be able to send data for predictive edge analytic to an integrated cloud IoT echo system.

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