DESIGN AND CONSTRUCTION OF A RAIN DETECTOR WITH AN ALARM SYSTEM

Supported by tetfund

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Abstract: From time immemorial man has used the sun to dry many things, a process known as sun drying. Sun drying is carried out in the farm, home, industry, laboratory, hospitals and other institution for a number of reasons. These reasons include totally driving out water molecules from the things being dried like clothes, some farm produce, during building work, industries where certain plants used for pharmaceutical/chemical purpose are exposed to direct sunlight for a little while to cause some chemical changes in them and at home when windows are opened to allow the sun rays to fall into rooms to eliminate dampness and allow for proper aeration. When rain falls, it will cause a setback to all the reasons for sun-drying enumerated above, especially when the materials being sun dried are not retrieved quickly. Thus, designing and constructing a device which gives one a heads-up the instant it starts to rain or serves an indicator as to whether rain will fall or not hopefully giving enough time to retrieve the materials being sun dried is a welcome idea. In this work, the designed and constructed rain detector with an alarm system using an Atmega 328p microcontroller chip was programmed using the arduino board. The constructed system has an alarm system and light Emitting Diode which buzzes and blinks immediately it starts to rain and a Liquid Crystal Display (LCD) which displays the intensity of the rain. The obtained experimental results showed changes in sensor reading to different Weather conditions; such as, for no rain, drizzle and heavy rainfall, respectively.

Keywords: Alarm, arduino, Atmega 328 PUP, detector, microcontroller, rain sensors

Introduction

Mankind has always harnessed the elements of nature for different purposes. Water for irrigation and Electricity generation (Fthenakis and Kim, 2010), wind for wind mill used for many applications ranging from turning turbines that generate electricity, to quarry for crushing stones, sun for drying, heating and generation of electricity (Mekhilef, Saidur and Safari, 2015). From time immemorial humans used the sun to dry many things, a process known as sun drying. Sun drying is carried out in the farm, home, industry, laboratory, hospitals and other institution for a number of reasons (Amos, 2014). According to Anastasi *et al.* (2009) these reasons range from totally driving out water molecules from the things being dried like clothes, some farm produce.

When rain falls, it causes a setback to all the reasons for sun-drying, especially when the materials being sun dried are not retrieved quickly (Bagree, 2012). Thus, designing and constructing a device which gives one a heads-up the instant it starts to rain, hopefully gives one time to retrieve the materials being sun dried. Also, since it can rain at any time without any warning, clothes in a clothing line outside the house that are almost dry may get wet again if they are not retrieved on time. Thus, this project will also help house wives and other users to be quickly alerted to avoid rain from wetting shirts/ dresses being sundried at the clothes line outside the house (Barnaghi *et al*., 2012).

Water/rain alarm detector is a self-contained electronic device that sounds an alarm when its sensor is in contact with water. It comprises of rain sensor (Jayant, 2015) and microcontroller (Hernando, 2016). It can be used near water heaters, washing machines, water pumps, bathtubs, toilets, dishwashers, and high-efficiency furnace pumps (Beard *et al.*, 2010). They may also be used to alert users when there is a moisture problem (Becker & Gudesen, 2000).

Materials and Method

Instruments

An Arduino board Uno (R3), LM 393 based rain sensor, Liquid crystal display (LCD), Atmega 328 Arduino microcontroller, Light emitting diode (LED), Power supply module (PSM), Buzzer, Socket, Variable resistor, connecting wires, Capacitors, Vero board, Switch, 16MHz Crystal Oscillator, Paper Capacitor and Jumper Wires, Soldering Iron, Soldering lead.

Construction

The block diagram for the circuit is as shown in Fig. 1. The project is based on the Atmega 328 microcontroller and the LM393 based rain sensor. The analog output of the rain sensor is connected to one of the analog inputs of the microcontroller. The values of the analog readings on the microcontroller are then read using the serial monitor of the arduino Integrated Development Environment (IDE) when the rain sensor is exposed to different intensity of water. Based on the readings, the microcontroller is then calibrated to trigger a Light Emitting Diode and a Buzzer when it is raining. The 16×2 Liquid Crystal Display is programmed to display the intensity of the rainfall.

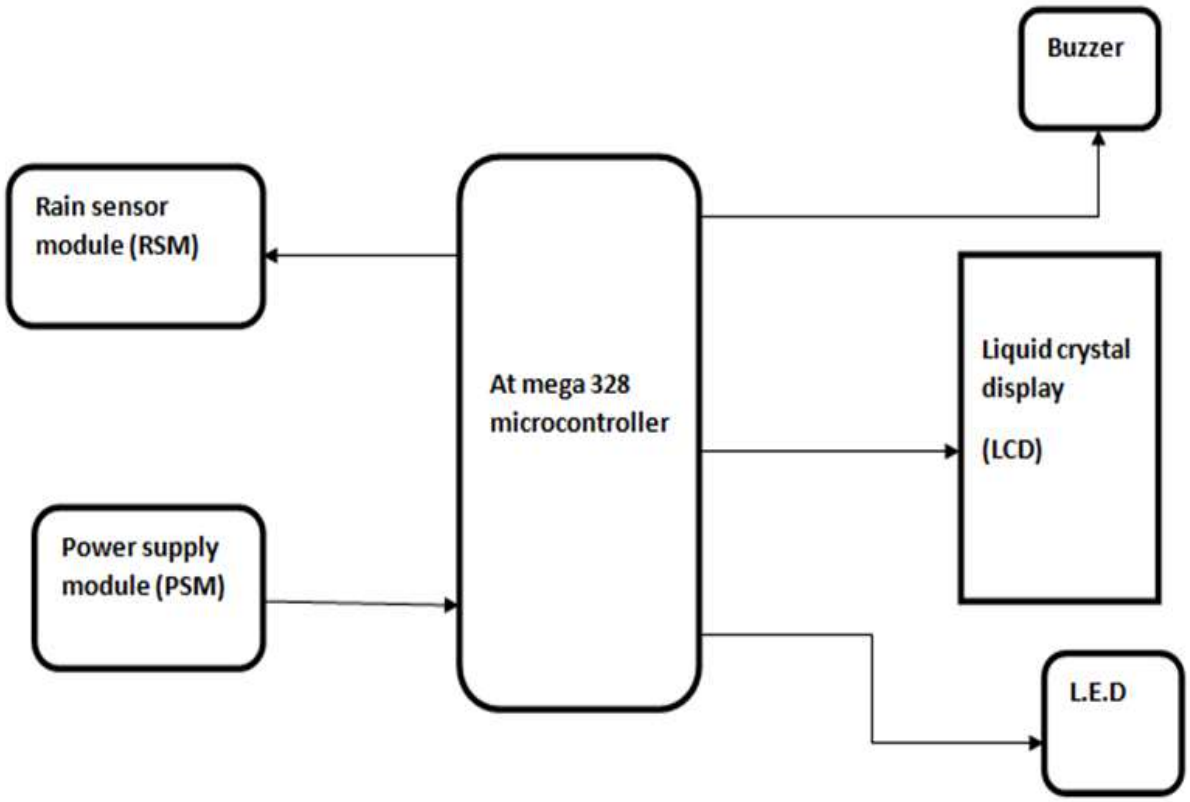

Fig. 1: Block diagram of the design

Table 1: Result of the sensor calibration experiment

S/N	State	Analog reading			Range
		First reading	Second reading	Third reading	
1	Sensor Dry	1023	946	900	900-1023
2	Sensor Wet	451	480	889	451-899
3	Sensor under heavy water	400	350	450	<450

Calibration of sensor

The rain detector has the rain sensor plate as the main component, if the rain sensor plate of the rain sensor module is in dry state; an analog output (AO) from the module is 5V which gets converted to 1023 by the analog to digital converter of the Arduino chip. During rain, the sensor plate elements are bridged by the rain water and hence this analog output gradually changes from 5V to a lower voltage in which the digital output changes as well, based on the moisture level between the sensor pads. By this way, the sensor reports the absence and presence of the rain in an analog way; this helps to determine the intensity of the rain by analyzing the output analog signal. The approximation is handled by a simple Arduino sketch. An additional function is delaying of the alert and the glowing generation; buzzer raises an alert only when raining at a detection of a certain threshold, within a pre-defined time interval. This extra feature helps in reducing false alarm counts to some extent.

A simple experiment was performed to obtain the readings obtained from the rain sensor when there was no rain, when it was raining and when it was raining very heavily. Table 1 shows the result of the experiment. The readings were obtained from the serial monitor of the arduino Integrated Development Environment (IDE).

Result and Discussion

Figure 2 shows the circuit diagram of the completed Circuit, Fig. 3 shows the circuit after construction without packaging while Fig. 4 shows the circuit after packaging. The sketch used for programming the arduino chip is shown in Appendix I.

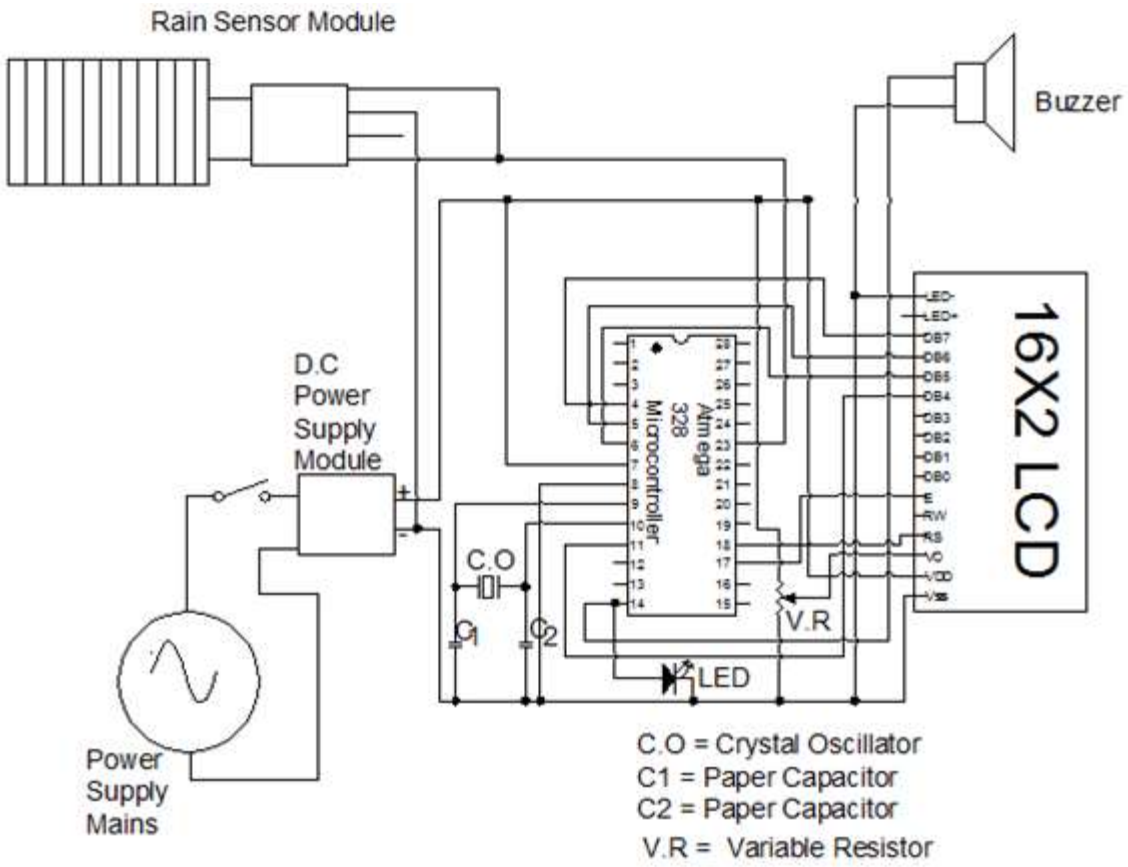

Fig. 2: Completed circuit diagram

In this research, the arduino was programmed to detect and display when the rain intensity is heavy, drizzling or low. The actions of the Buzzer and Light Emitting Diode were determined by the intensity of the rain. Raju (2017) used the rain sensor module, temperature sensor and the arduino microcontroller for automatic farm irrigation. Ruby and Jawahar (2017) worked on smart agriculture to prevent crops from spoilage during rain and efficiently recycle rain water for irrigation. They made use of the wifi module, rain sensors, GSM module and the Arduino microcontroller. Latha and Murthy (2016) worked on a GSM based rainfall detector using Arduino. In their work, a rain sensor module with LM393 interfaced with the Arduino microcontroller was used for rainfall measurement, the measured values were transferred via text message to a specified mobile number for analysis.

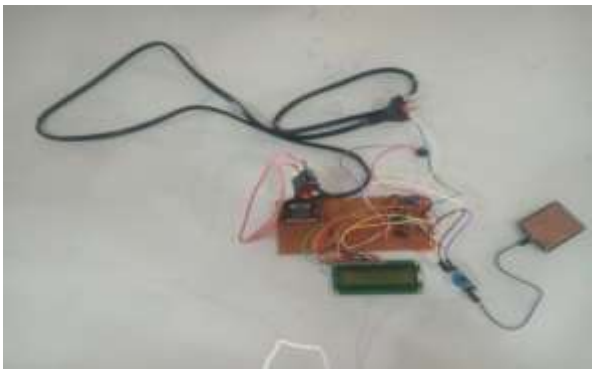

Fig. 3: Completed circuit before packaging

Fig. 4: Completed circuit after packaging

The research works referenced above made use of rain sensor module and arduino microcontroller to sense and measure rainfall. Results obtained shows that the method and result of this research is in agreement with that of other similar researches carried out by other researchers round the world.

Conclusion

This project is the design and construction of a rain detector with an alarm system that can detects rain fall, the device was able to detect any moisture or drop of liquid on the rain sensor panel or board using an embedded system for the detection of rain and its program into the microcontroller (Atmega 328).

It may be concluded that the aim and objectives of the project have been met by designing and constructing a rain detector with an alarm system which may be used for demonstration purpose only. The rain detector with an alarm system constructed has the capability to sense rainfall and tells when it is heavy or low. Moreover, the system was designed, implemented and tested within the constraints of available

components and instruments. The results of the tests show as satisfactory the reliability of the various units and the system as a whole.

Future work would consist of redesigning of a rain detector with an alarm system that include a rechargeable battery which may be solar powered as the source of power to avoid the current interruption as it is when using town power supply, because in the absence of power the system wouldn't work anymore and that will render the system not reaching its significance. Furthermore a more complex calibration should be made on the sensor to give a more detailed reading or information about the weather condition.

Conflict of Interest

Authors have declared that there is no conflict of interest reported in this work.

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APPENDIX I: The Arduino Sketch for the Microcontroller Used in the Project

The complete Syntax used to program the Arduino Chip (Atmega 328 microcontroller):

```
// include the library code:
#include <LiquidCrystal.h>
// initialize the library by associating any needed LCD interface pin
// with the arduino pin number it is connected to
const int rs = 12, en = 11, d4 = 5, d5 = 4, d6 = 3, d7 = 2;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);
int rainSensePin= 0; // analog pin 0 - sensor i/p
int alertPin= 8; // digital pin 8 - alert o/p
int curCounter= 0; // current counter - goes up by 1 every second while sensing
void setup(){
   // set up the LCD's number of columns and rows:
  lcd.begin(16, 2);
Serial.begin(9600);
pinMode(alertPin, OUTPUT);
pinMode(rainSensePin, INPUT);
lcd.setCursor (0,0);
lcd.print("RAIN DETECTOR");
delay (3000);
lcd.clear();
}
void loop()
{
int rainSenseReading = analogRead(rainSensePin);
float counter = (millis() / 1000);
lcd.clear();
// check to see how long it is raining at the threshold level
   // rain strength value from 0 - 1023
   // heavy rain -to- no rain.
if (rainSenseReading<= 450){ // end of the time delay
digitalWrite(alertPin, HIGH);  //raise an alert after x time
delay (100);
digitalWrite (alertPin, LOW);
lcd.setCursor(0, 0);
  lcd.print("HEAVY RAINFALL");
  lcd.setCursor (0,1);
```

```
    lcd.print(rainSenseReading);
    Serial.println(rainSenseReading);
    delay (500);
    lcd.clear();
  }
if ((rainSenseReading>450)&& (rainSenseReading<900)){ // end of the time delay
digitalWrite(alertPin, HIGH);  //raise an alert after x time
delay (500);
digitalWrite (alertPin, LOW);
lcd.setCursor(0, 0);
  lcd.print("WET/LOW RAINFALL");
  lcd.setCursor(0,1);
    lcd.print(rainSenseReading);
    delay (1000);
    lcd.clear();
}
if (rainSenseReading> 900){ // end of the time delay
digitalWrite(alertPin, LOW);  //raise an alert after x time
lcd.setCursor(0, 0);
  lcd.print("NOT RAINING");
  lcd.setCursor(0,1);
    lcd.print(rainSenseReading);
    delay (2000);
    lcd.clear();
}}
```