WEATHER FORECASTING SYSTEM

Abstract

Weather forecasting is the application of science and technology to predict the state of the atmosphere for a given location.Ancient weather forecasting methods usually relied on observed patterns of events, also termed pattern recognition. For example, it might be observed that if the sunset was particularly red, the following day often brought fair weather.However, not all of these
predictions prove reliable.
Here this system will predict weather based on parameters such as temperature, humidity and wind. User will enter the current temperature; humidity and wind, System will take this parameter and will predict weather(rainfall in inches) from previous data in the database(dataset). The role of the admin is to add previous weather data in the database, so that the system will calculate weather(estimated rainfall in inches) based on these data. Weather forecasting system takes parameters such as temperature, humidity, and wind and will forecast weather based on previous records therefore this prediction will prove reliable. This system can be used in Air Traffic, Marine, Agriculture, Forestry, Military, and Navy etc.

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Chapter 1

Introduction

1.1 Introduction

Weather forecasting is the application of science and technology to predict the state of the atmosphere for a given location. Human beings have attempted to predict the weather informally for millennium and formally since the nineteenth century. Weather forecasts are made by collecting quantitative data about the current state of the atmosphere on a given place and using scientific understanding of atmospheric processes to project how the atmosphere will evolve in that place. Weather is driven by air pressure (temperature and moisture) differences between one place and another. These pressure and temperature differences can occur due to the sun angle at any particular spot, which varies by latitude from the tropics. The atmosphere is a chaotic system, so small changes to one part of the system can grow to have large effects on the system as a whole. This makes it difficult to accurately predict weather more than a few days in advance, though weather forecasters are continually working to extend this limit through the scientific study of weather, meteorology. It is theoretically impossible to make useful day-to- day predictions more than about two weeks ahead, imposing an upper limit to potential for improved prediction skills.

Once an all-human endeavor based mainly upon changes in barometric pressure, current weather conditions, and sky condition, weather forecasting now relies on computer-based models that take many atmospheric factors into account. Human input is still required to pick the best possible forecast model to base the forecast upon, which involves pattern recognition skills, tele-connections, knowledge of model performance, and knowledge of model biases.

1.2 Motivation

- The U.S. arguably has the world's worst weather: hurricanes, tornados, large hail, blizzards, droughts, heat waves….
- Hazardous weather is the reason the National Weather Service (NWS) was founded.
- The mission of the NWS is to reduce the loss of life and the loss of property associated with weather related hazards, and to mitigate the economic impact of disruptive weather.
- Weather forecasters look at the current state of the weather and forecast maps and add their personal experience to come up with a forecast and to issue warnings.

1.3 Objectives

There are several reasons why weather forecasts are important. They would certainly be missed if they were not there. It is a product of science that impacts the lives of many people. The following is a list of various reasons why weather forecasts are important:

1. Helps people prepare for how to dress (i.e. warm weather, cold weather, windy weather, rainy weather)
2. Helps businesses and people plan for power production and how much power to use (i.e. power companies, where to set thermostat)
3. Helps people prepare if they need to take extra gear to prepare for the weather(i.e. umbrella, rain coat, sun screen)
4. Helps people plan outdoor activities (i.e. to see if rain/storms/cold weather will impact outdoor event)
5. Helps curious people to know what sort of weather can be expected (i.e. a snow on the way, severe storms)
6. Helps businesses plan for transportation hazards that can result from the weather(i.e. fog, snow, ice, storms, clouds as it relates to driving and flying for example)
7. Helps people with health related issues to plan the day (i.e. allergies, asthma,heat stress)
8. Helps businesses and people plan for severe weather and other weather hazards(lightning, hail, tornadoes, hurricanes, ice storms).
9. Helps farmers and gardeners plan for crop irrigation and protection (irrigation scheduling, freeze protection).

Chapter 2

The Proposed System

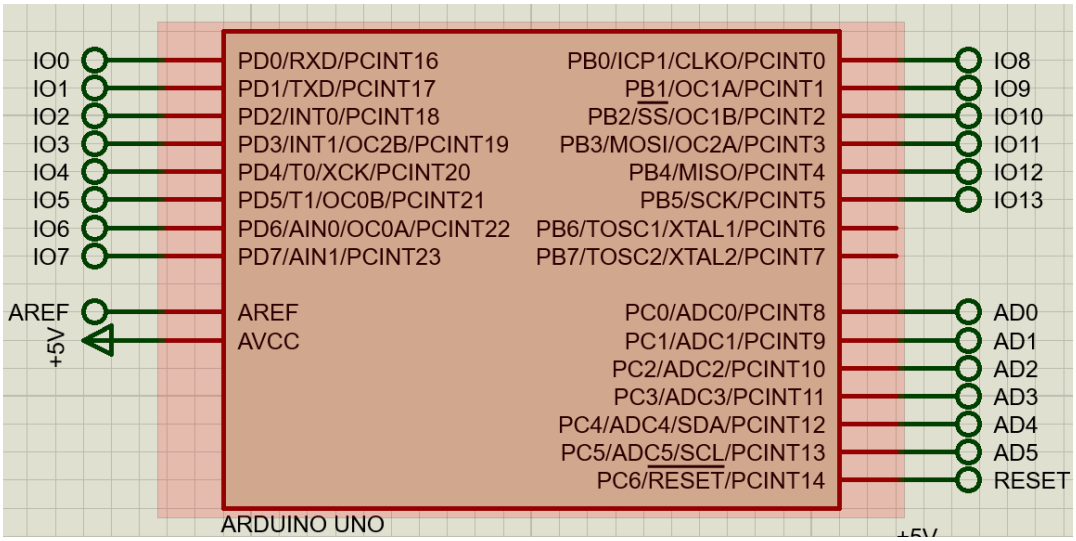
2.1 Introduction

User will enter the current temperature; humidity and wind, System will take this parameter and will predict weather from previous data in the database. The role of the admin is to add previous weather data in the database, so that the system will calculate weather based on these data. Weather forecasting system takes parameters such as temperature, humidity, and wind and will forecast weather based on previous records therefore this prediction will prove reliable.

2.2 Components

1. Arduino UNO

Arduino Uno is a microcontroller board based on the ATmega328. Arduino is an open-source, prototyping platform and its simplicity makes it ideal for hobbyists to use as well as professionals. The Arduino Uno has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

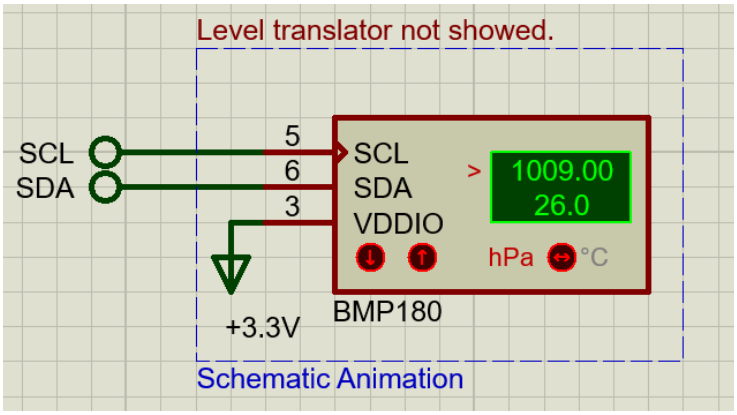


Features:

- Microcontroller: ATmega328
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB (ATmega328)
- EEPROM: 1 KB (ATmega328)
- Clock Speed: 16 MHz

2. BMP180 Sensor:

The BMP180 sensor is mainly used to measure atmospheric pressure or barometric pressure. The working principle of the air pressure sensor is very simple, it works based on the weight of air. Because the air around us has a certain weight, and this weight has a specific pressure.

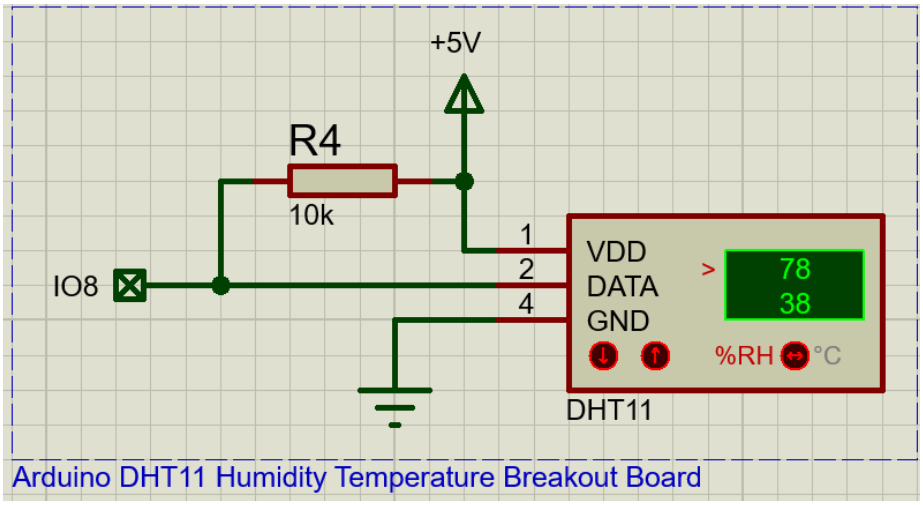


Features :

- Can measure temperature and altitude.
- Pressure range: 300 to 1100hPa
- High relative accuracy of ±0.12hPa
- Can work on low voltages
- 3.4Mhz I2C interface
- Low power consumption (3uA)
- Pressure conversion time: 5msec
- Potable size

3.DHT11 Temperature & Humidity sensors:

DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.

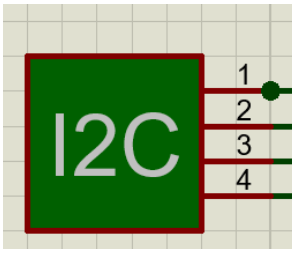


Features :

- Ultra low cost
- 3 to 5V power and I/O
- 2.5mA max current use during conversion (while requesting data)
- Good for 20-80% humidity readings with 5% accuracy
- Good for 0-50°C temperature readings ±2°C accuracy
- No more than 1 Hz sampling rate (once every second)
- Body size 15.5mm x 12mm x 5.5mm
- 4 pins with 0.1" spacing

4. Grove - I2C:

I2C Hub Grove is an extension Grove module for connecting multiple I2C devices to Grove Base Shield. It can be used with Universal 4 Pin to X2 4 Pin cable and connects up to 3 I2C devices which may cover most developing purposes.



It does not conflict if you use the same I2C Socket simultaneously because every I2C device has its own address.

Features:

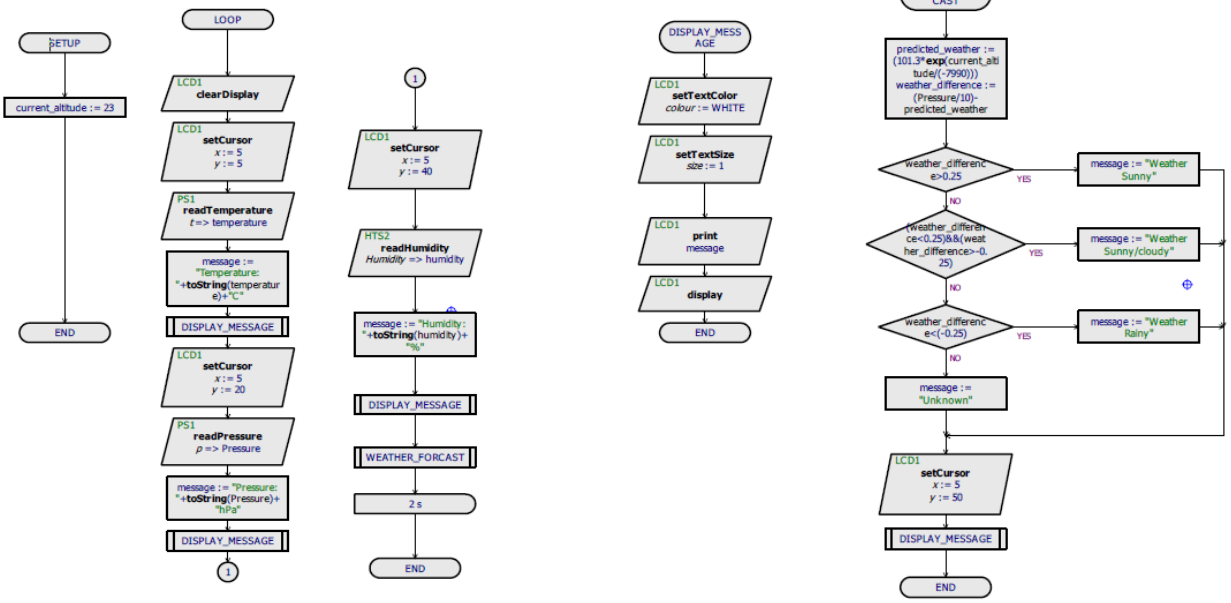
- Chainable

5. Wires

A jump wire (also known as jumper wire, or jumper) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

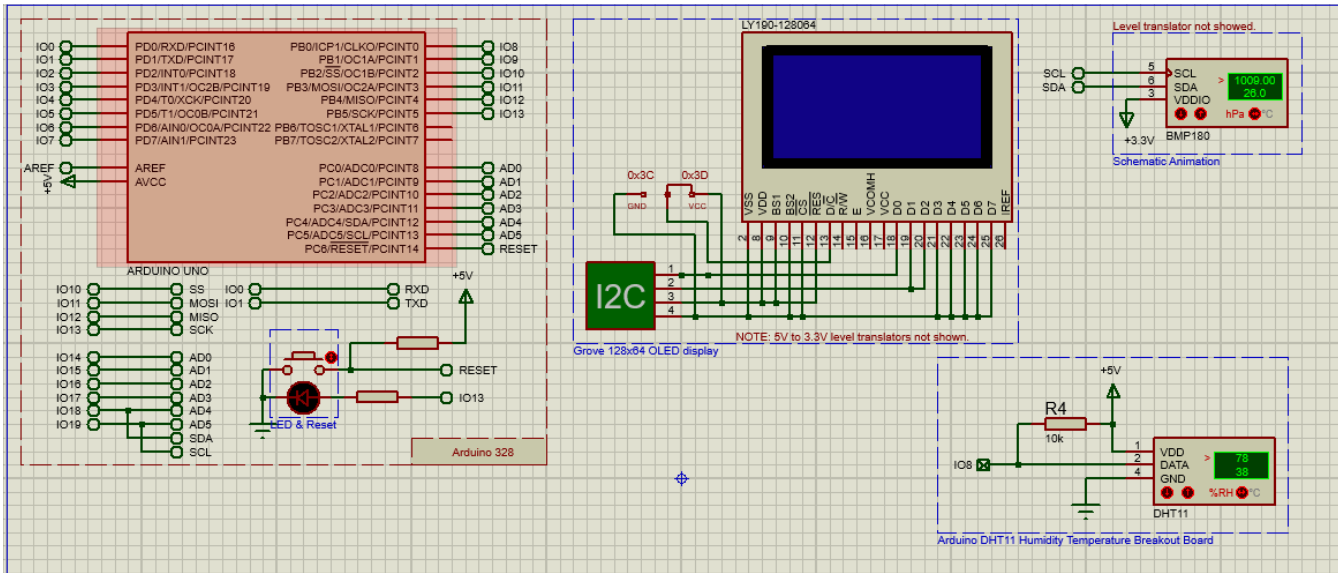
Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

2.3 Block Diagram



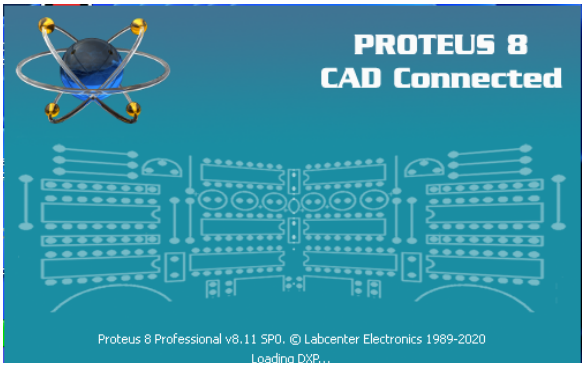
Implementation

3.1 Connections

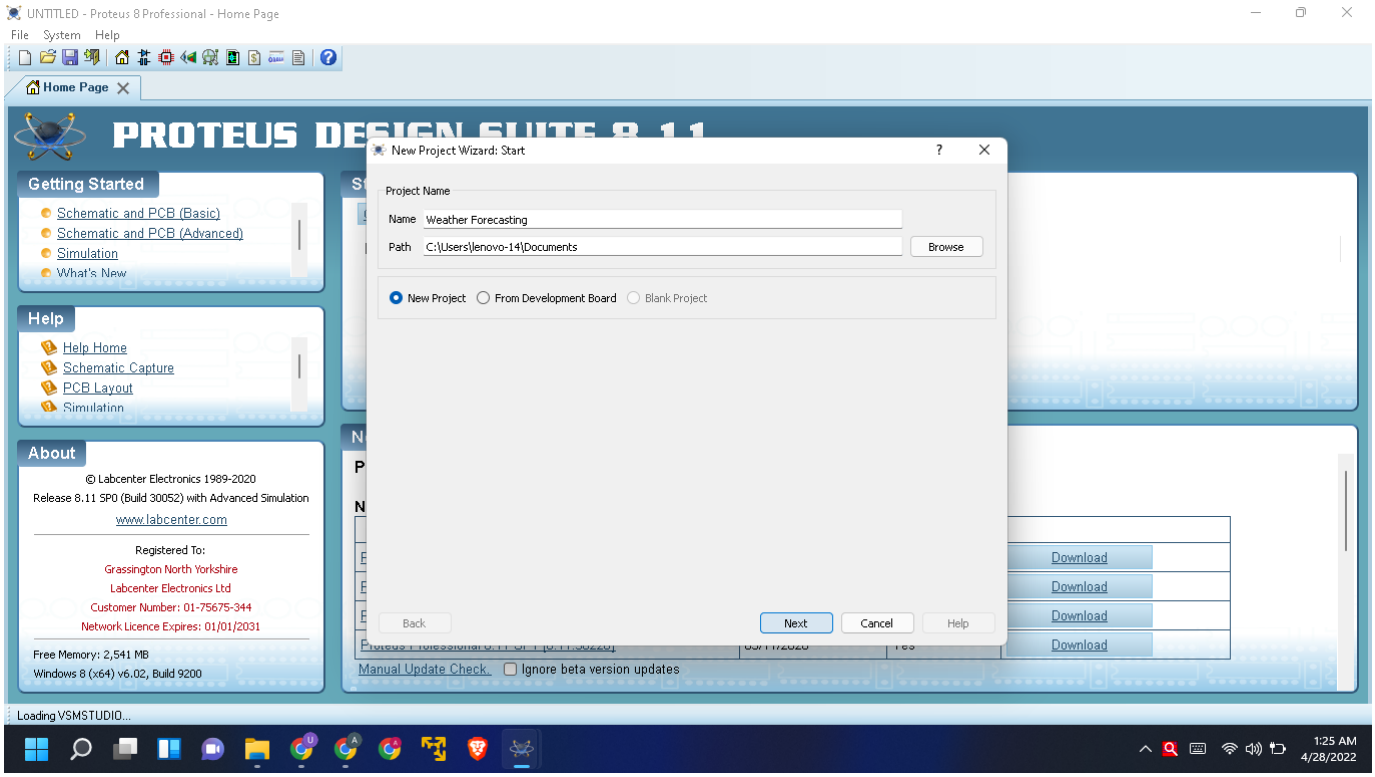


3.2 Working

1. Download Proteus 8 professional. Complete the setup of it.

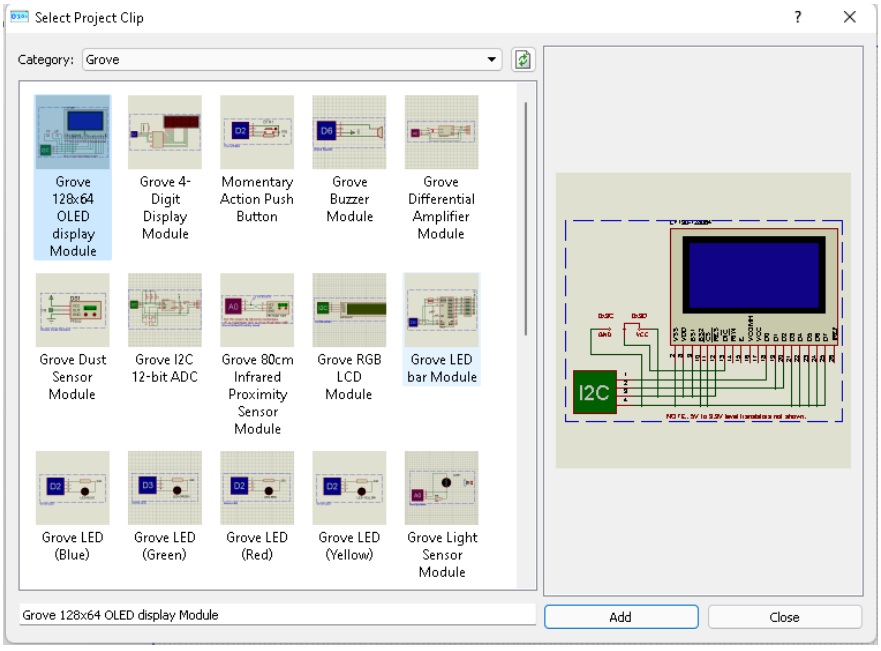


2. Create a New Project and set all the selects as defaults.

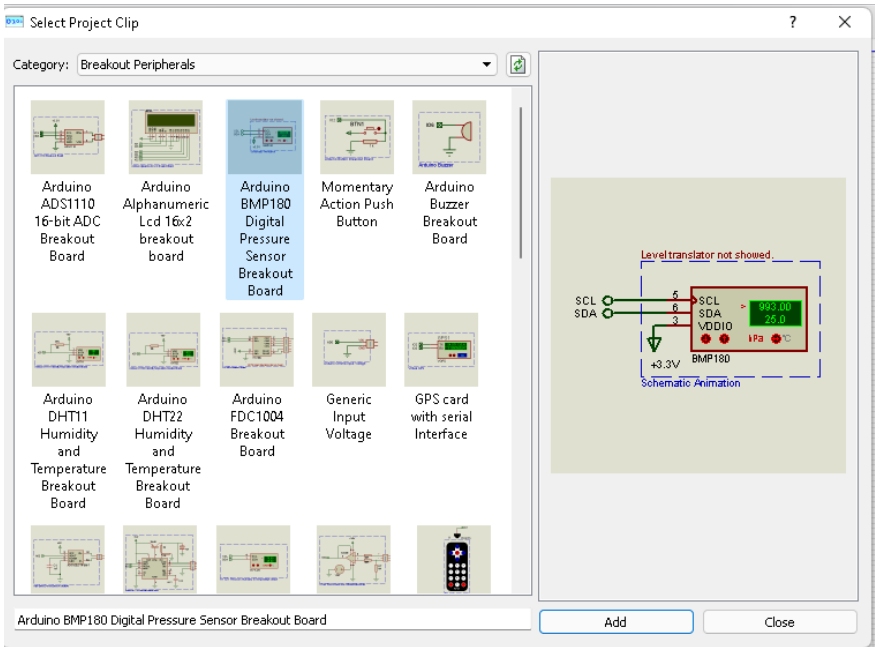


3. After Creating new project, Added the Project Clips. These clips have sensors, displays & other components which are used in this project.

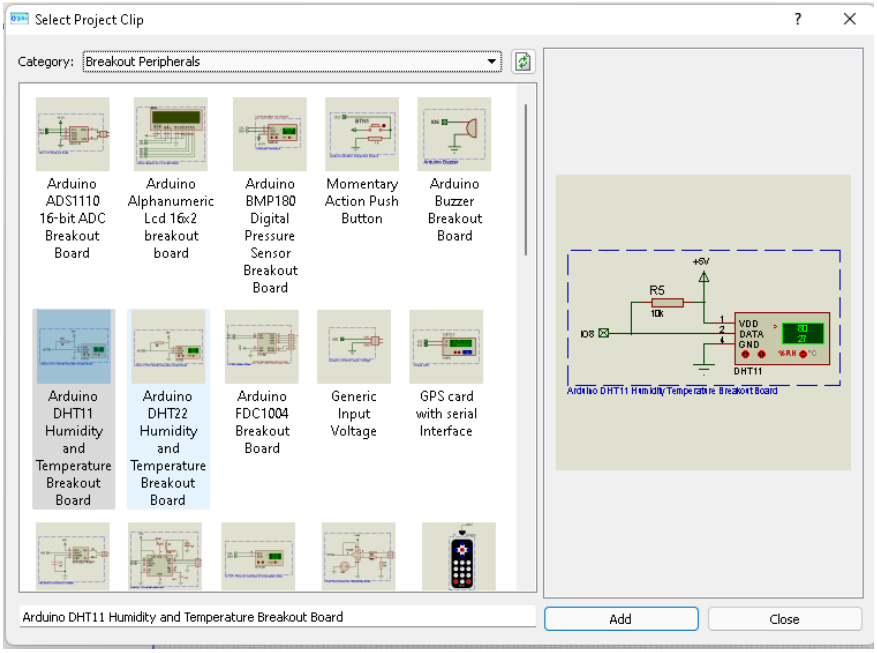
1. LCD1: This is an LCD from the Groove section in which the output & reading are shown i.e. connected with I2C.



2. PS1: This is a Pressure Sensor which is used for Checking the Pressure.



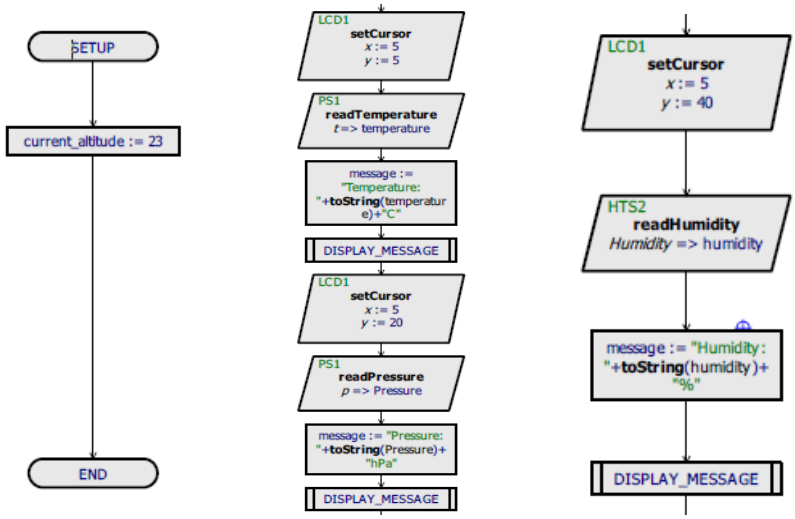
3. HTS2: This is a clip of the Breakout Board of Arduino DHT11 Humidity & Temperature.



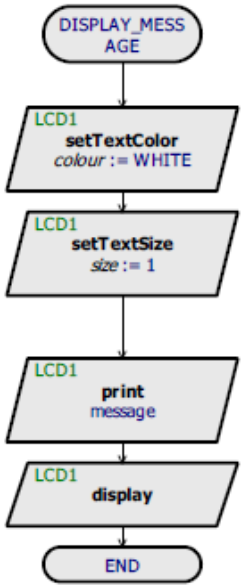
4. Start Creating a Flowchart by that the connection will flow:
    1. Firstly we create three start & end points in that first one will be set up, second one will Loop & last will be Display_Message function.
    2. In the setup section assigning variables and their data type.
        - Temperature - Float
        - Pressure - Float

- Humidity - Float
- Current Altitude - Integer(This is the height from we checking the weather report)

3. Start assigning the value to altitude and get the values of temperature, pressure & Humidity from the sensor.

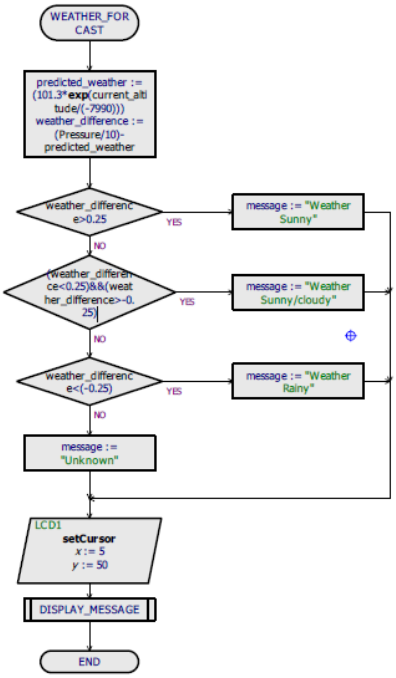


4. Along with this we are going to set the display temperature, pressure & humidity data on LED1 by Display_Message function. we are passing arguments of x & y that we are separating according to coordinates.
5. We set the color of display & font size of text in Display_Message.

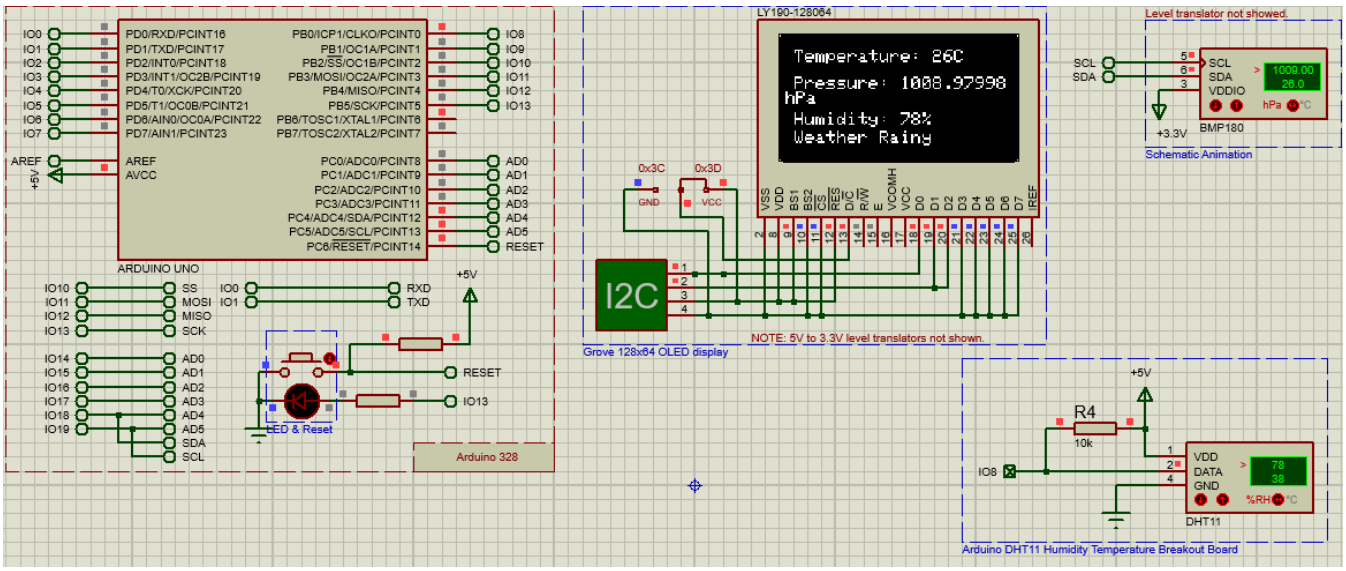


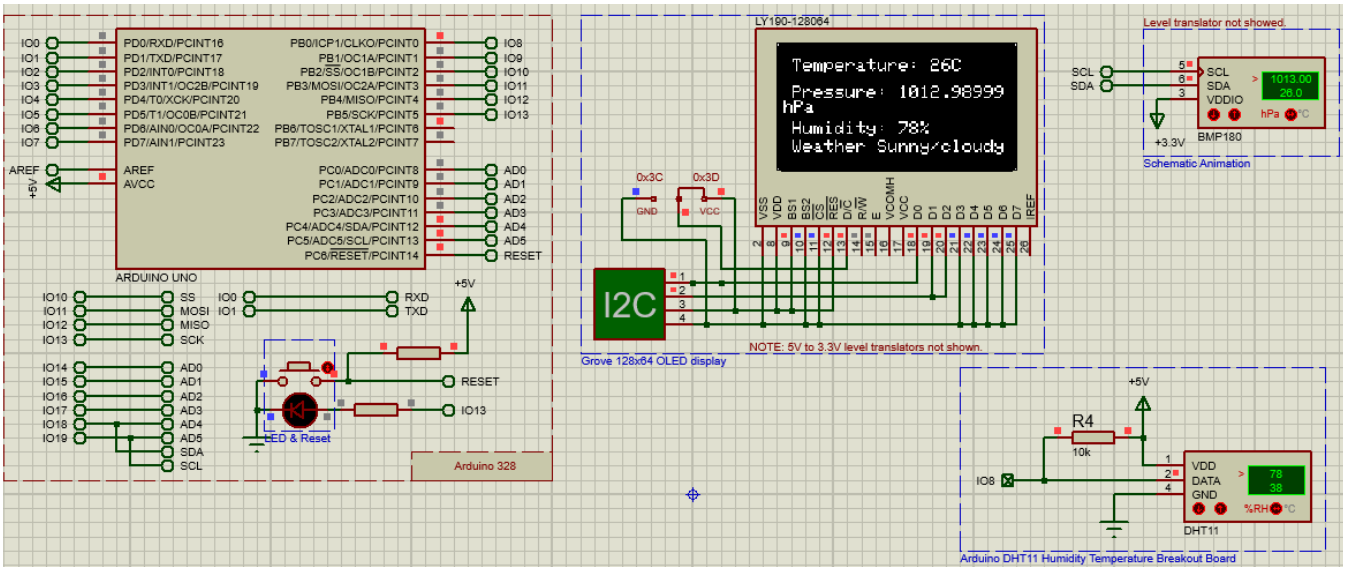
6. Also we are creating another function named weather_forecast.
    a. In this we define some variables predicted_weather & weather_difference both have float data type.
    b. predicting _weather, we will have formula of (101.3*exp(current_altitude/(-7990))).
    c. Value of predicted_weather will change according to altitude.

d. After that we will calculate weather_difference ((Pressure/10)-predicted_weather).
e. The weather depends upon pressure so if the value of weather changes accordingly the weather will change.
f. If weather_difference have values:
    - Weather_difference >0.25 then the weather will be **RAINY.**
    - weather_difference<0.25 && weather_difference>-0.25 then the weather will be **SUNNY/RAINY.**
    - Weather_difference <0.25 then the weather will be **SUNNY.**
g. According to the weather_difference the weather will be shown on Display.



7. After running the flowchart:


LY190-128064
Temperature: 26C
Pressure: 1008.97998 hPa
Humidity: 78%
Weather Raing
Level translator not showed.
SCL
SDA
1009.00
26.0
BMP180
Schematic Animation
ARDUINO UNO
Arduino 328
LED & Reset
Grove 128x64 OLED display
NOTE: 5V to 3.3V level translators not shown.
R4
10k
DHT11
Arduino DHT11 Humidity Temperature Breakout Board


LY190-128064
Temperature: 26C
Pressure: 1012.98999 hPa
Humidity: 78%
Weather Sunny/cloudy
Level translator not showed.
SCL
SDA
1013.00
26.0
BMP180
Schematic Animation
ARDUINO UNO
Arduino 328
LED & Reset
Grove 128x64 OLED display
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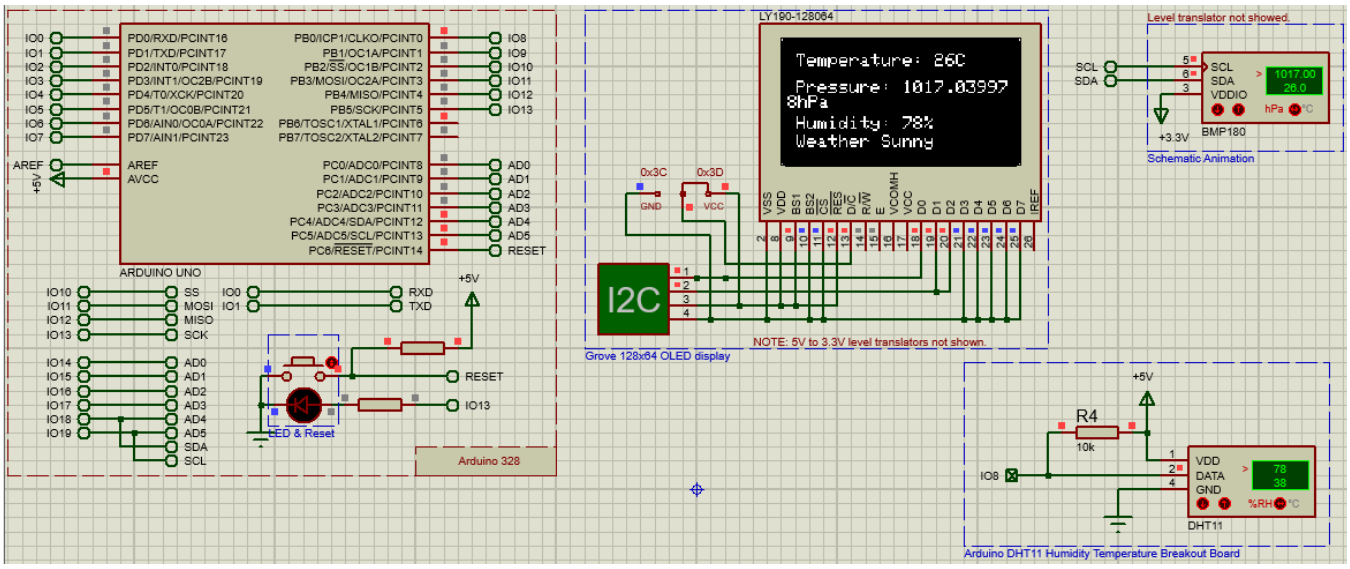
LY190-128064
Temperature: 26C
Pressure: 1017.03997 hPa
Humidity: 78%
Weather Sunny
Level translator not showed.
SCL
SDA
1017.00
26.0
BMP180
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NOTE: 5V to 3.3V level translators not shown.
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Arduino DHT11 Humidity Temperature Breakout Board

3.3 Analysis:

While data-access policies differ by country, all of these reports are sent to regional and global centers through the World Meteorological Organization's (WMO) Global Telecommunications System (GTS).
The data is then compiled, redistributed in the GTS, and used in various numerical forecasting models. Typically, these numerical models begin with data collected between the hours of 0000 and 1200 UTC (7 A.M. and 7 P.M. Eastern Standard Time, respectively).
To aid the forecaster, the data is printed, mapped, and graphed in several ways. Furthermore, some "initialization" routines slightly change the data when it enters a prediction model only for that model

1. By this simulation we analyzed that, According to change in atmospheric pressure the weather will also change.
2. If we know our current altitude h, then we can find this formula by that we can easily find the report of weather.
3. **Weather_differnce = ((Pressure/10)-(101.3*exp(current_altitude/(-7990))))**
4. **If the weather_differnce changes according to that the report will be changed.**

Analysis	Output
dP > +0.25 kPa	Sun Symbol
-0.25 kPa < dP < 0.25 kPa	Sun/Cloud Symbol
dP < -0.25 kPa	Rain Symbol

Chapter 4

Conclusion

Weather forecasting, the prediction of the weather through application of the principles of physics, supplemented by a variety of statistical and empirical techniques. In addition to predictions of atmospheric phenomena themselves, weather forecasting includes predictions of changes on Earth's surface caused by atmospheric conditions—e.g., snow and ice cover, storm tides, and floods.

Weather forecasting is the prediction of the state of the atmosphere for a given altitude using the application of science and technology. This includes temperature, rain, cloudiness, pressure and humidity.

Weather warnings are important forecasts because they are used to protect life and property. Forecasts based on temperature and precipitation are important to agriculture, and therefore to traders within commodity markets.

References:

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