An Arduino Based Assistant

Digital System Design Sessional

Section B1 Group 5

Bangladesh University of Engineering and Technology

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Contents

1 Group Members

1. Monjur-E-Rasul (#1305028)
2. Imran Hossen (#1305032)
3. Ananya Bhattacharjee (#1305046)
4. Abir Shafi Bindu (#1305052)
5. Md. Al-amin (#1305054)

2 Course Teachers

1. Md. Abdus Sattar
2. Sukarna Barua
3. Md.Aashikur Rahman Azim

3 Description

The main purpose of our project is build a device, which can help in our day-to-day life measuring the weather parameters. The device will send the necessary information or suggestion to android device via bluetooth when asked. We have provided the information of temparature and humidity of the environment and whether there is rain or not. According to this information, we try to suggest song and activities. The device can also be used for setting alarm and to-do list.

4 Required Equipments

1. Arduino UNO
2. PIR Motion Sensor
3. DS3231 Real Time Clock
4. DHT22 Humidity and Temperature Sensor
5. FC-37 Rain Drop Module
6. HC-05 Bluetooth Module
7. Buzzer

4.1 Arduino UNO

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits.

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

4.2 PIR Motion Sensor

The PIR Motion sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected.

4.3 DHT22 Temperature and Humidity Sensor

These sensors consist of a humidity sensing component, a NTC temperature sensor (or thermistor) and an IC on the back side of the sensor.For measuring temperature and humidity they use the sensing component which has two electrodes with moisture holding substrate between them. So as the humidity changes, the conductivity of the substrate changes or the resistance between these electrodes changes. This change in resistance is measured and processed by the IC which makes it ready to be read by an arduino.

4.4 FC–37 Rain Drop Module

The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The module features, a rain board and the control board that is separate for more convenience, power indicator LED and an adjustable sensitivity though a potentiometer. The analog output is used in detection of drops in the amount of rainfall.Connected to 5V power supply, the LED will turn on when induction board has no rain drop, and DO output is high. When dropping a little amount water, DO output is low, the switch indicator will turn on. After brushing off the water droplets, and restoring to the initial state, outputs will be high.

4.5 DS3231 Real Time Clock

The DS3231 is a low-cost, extremely accurate I^2C real-time clock (RTC) with an integrated temperature-compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery input, and maintains accurate timekeeping when main power to the device is interrupted. The integration of the crystal resonator enhances the long-term accuracy of the device as well as reduces the piece-part count in a manufacturing line. The DS3231 is available in commercial and industrial temperature ranges, and is offered in a 16-pin, 300-mil SO package.

The RTC maintains seconds, minutes, hours, day, date, month, and year information. The date at the end of the month is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format with an active-low AM/PM indicator. Two programmable time-of-day alarms and a programmable square-wave output are provided. Address and data are transferred serially through an I^2C bidirectional bus.

4.6 HC–05 Bluetooth Module

HC–05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle.

5 How it works?

5.1 Working procedures

1. Arduino Uno for interfacing to various hardware peripherals.
2. The PIR Motion sensor is used to identify movement. Then it waits for data.
3. The DHT22 is used to measure the humidity and temparature.
4. Rain sensor(FC–37) is used for measuring rain. The range of rain measurement is divided in four parts.
5. Then songs and activities suggestions are sent to android device through bluetooth(HC–05).
6. There is also arrangements for setting alarm.
7. DS3231 rtc module is used as real time clock.
8. A buzzer is used for sound of alarm.
9. To-do list can also be set.
10. All data are sent through HC–05.

5.2 Quantization of environment

Kawamura's Discomfort Index (DIK) to quantify the daily temperature and humidity :

$$DIK = (0.99 \times T) + (0.36 \times T_d) + 41.5$$

T is the mean air temperature (°C)
T_d is mean dew point temperature (°C)

Three thermal comfort zones:

- Cold $(DIK \leq 60)$
- Comfortable $(60 < DIK \leq 75)$
  - Comfortable-hot $(60 < DIK \leq 67.5)$
  - Comfortable-cold $(67.5 < DIK < 75)$
- Hot $(DIK \geq 75)$

Relative humidity gives the ratio of how much moisture the air is holding to how much moisture it could hold at a given temperature.

$$R_H = 100 \times \frac{E}{E_s}$$

R_H is relative humidity (in percent)
According to an approximation of the Clausius-Clapeyron equation:

$$E = E_0 \times \exp\left[\left(\frac{L}{R_v}\right)\left(\frac{1}{T_0} - \frac{1}{T_d}\right)\right]$$

$$E_s = E_0 \times \exp\left[\left(\frac{L}{R_v}\right)\left(\frac{1}{T_0} - \frac{1}{T}\right)\right]$$

where $E_0 = 0.611kPa$, $\left(\frac{L}{R_v}\right) = 5423\ K$(in Kelvin, over a flat surface of water), $T_0 = 273\ K\ (\ Kelvin\ )$. T_d is dew point temperature also in Kelvin.

$$T_d = \left[\frac{1}{T} - \frac{1}{5423}\ln\left(\frac{R_H}{100}\right)\right]^{-1}$$

A simpler calculation that gives an approximation of dew point temperature if you know the observed temperature and relative humidity, the following formula was proposed in a 2005 article by Mark G. Lawrence in the Bulletin of the American Meteorological Society :

$$T_d = T - \left(\frac{100 - R_H}{5}\right)$$

Both $T_d\ \&\ T$ are in degree celsius. Apparently this relationship is fairly accurate for relative humidity values above 50%.

6 Algorithm

1. Start
   (a) if time = Set time for Alarm
      - Alarm

   (b) if(movement)
      i. if data="Alarm"
         - set Alarm

      ii. else if data="Todo"
         - set activity list

      iii. else if data="List"
         - see activity list

      iv. else if data="Weather"
         - show temparature, humidity and rain probability
         - suggest song and activity

   (c) goto(a)

7 Diagrams

7.1 Block Diagram

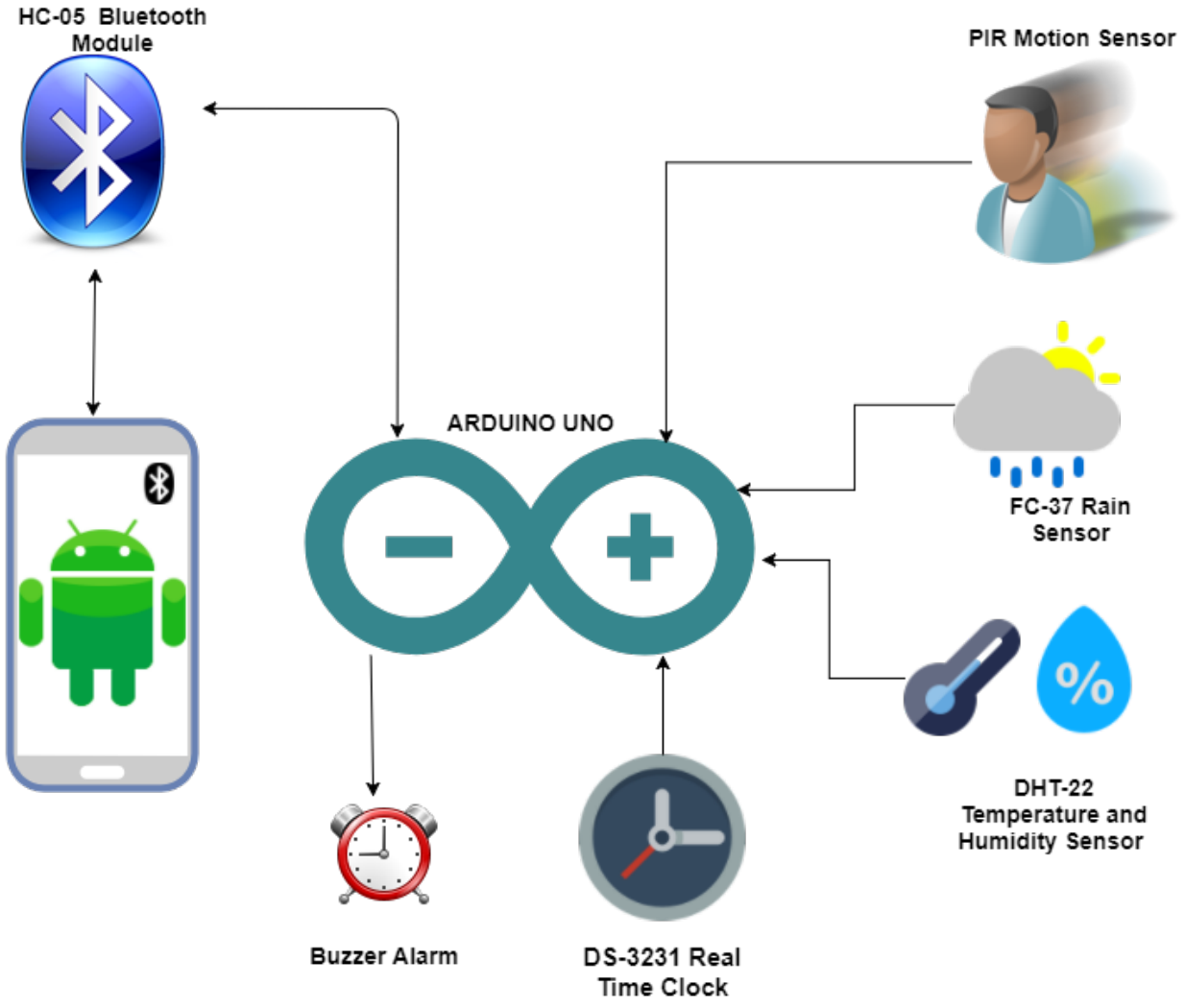


Fig : Block diagram

7.2 Sensors workflow

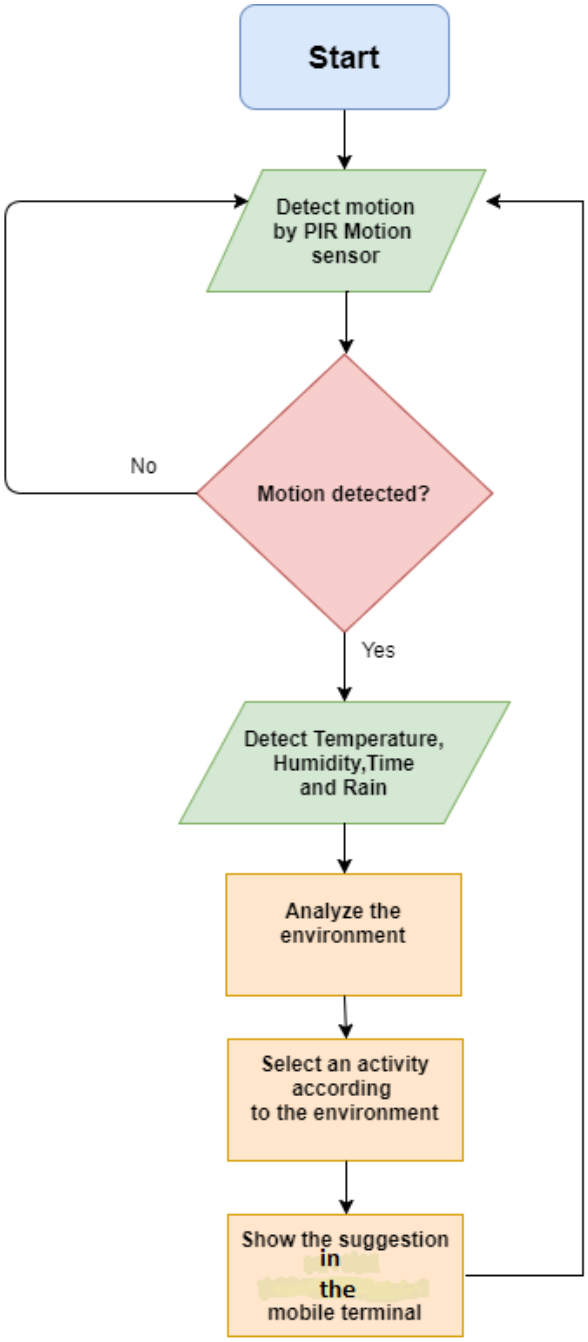


Fig : Flow chart

7.3 Wireless command flow chart

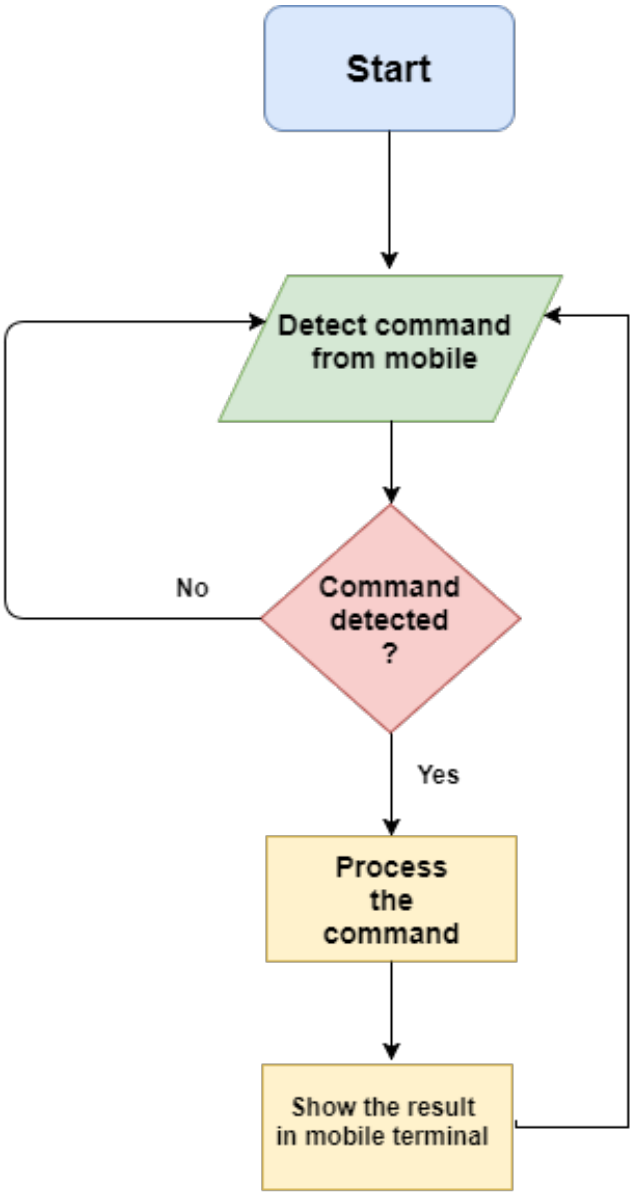


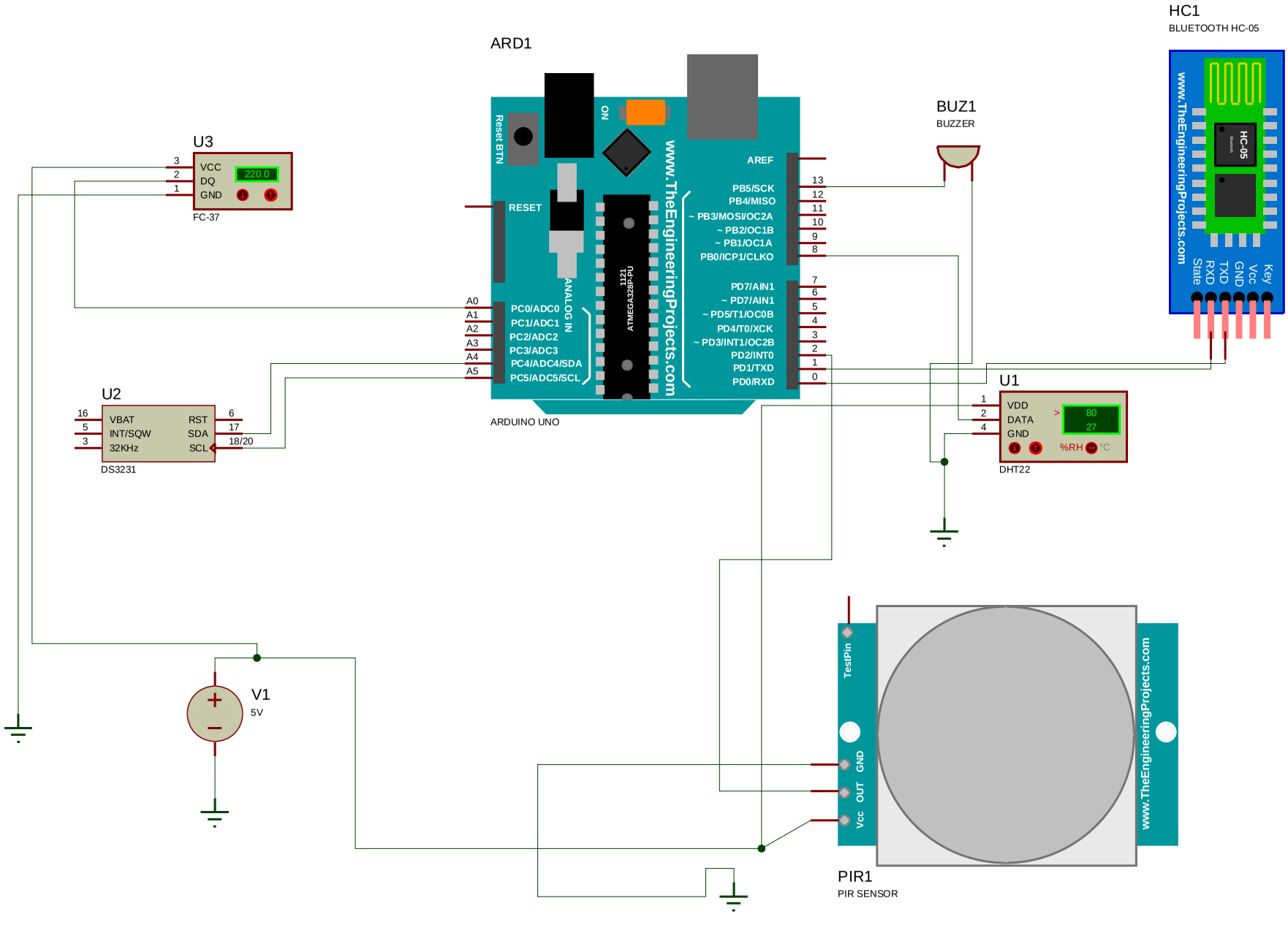
Fig : Flow Chart (Wireless Command)

8 Problems Faced

1. We had problems in setting baud rate for bluetooth device.
2. Whenever power source was unplugged, we had to manually set time for DS3231 RTC module.
3. We had problems in setting the ranges in rain sensor.

9 Project Video

Click here to watch the video


HC1
BLUETOOTH HC-05
www.TheEngineeringProjects.com
HC-05
Key
Vcc
GND
TXD
RXD
State
ARD1
Reset BTN
ON
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AREF
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PB5/SCK
PB4/MISO
~ PB3/MOSI/OC2A
~ PB2/OC1B
~ PB1/OC1A
PB0/ICP1/CLKO
ANALOG IN
PC0/ADC0
PC1/ADC1
PC2/ADC2
PC3/ADC3
PC4/ADC4/SDA
PC5/ADC5/SCL
PD7/AIN1
~ PD7/AIN1
~ PD5/T1/OC0B
PD4/T0/XCK
~ PD3/INT1/OC2B
PD2/INT0
PD1/TXD
PD0/RXD
ATMEGA328P-PU
ARDUINO UNO
BUZ1
BUZZER
U3
VCC
DQ
GND
220.0
FC-37
U2
VBAT
INT/SQW
32KHz
RST
SDA
SCL
DS3231
U1
VDD
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GND
80
27
%RH
°C
DHT22
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5V
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OUT
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PIR1
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