Mar. 12

# FINAL YEAR PROJECT REPORT

## (COMPUTERIZED WEATHER STATION)


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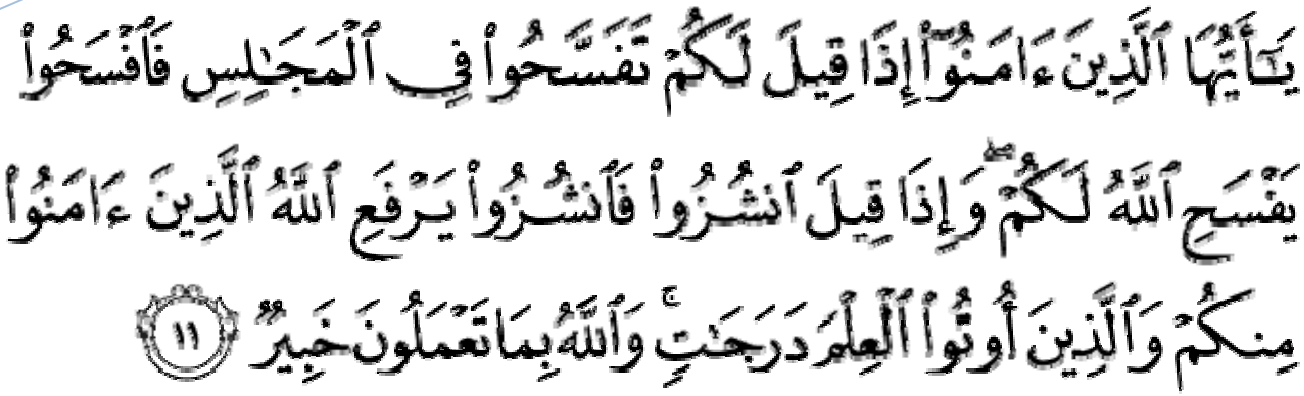
*IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL.*


يَٰٓأَيُّهَا ٱلَّذِينَ ءَامَنُوٓاْ إِذَا قِيلَ لَكُمۡ تَفَسَّحُواْ فِي ٱلۡمَجَٰلِسِ فَٱفۡسَحُواْ
يَفۡسَحِ ٱللَّهُ لَكُمۡۖ وَإِذَا قِيلَ ٱنشُزُواْ فَٱنشُزُواْ يَرۡفَعِ ٱللَّهُ ٱلَّذِينَ ءَامَنُواْ
مِنكُمۡ وَٱلَّذِينَ أُوتُواْ ٱلۡعِلۡمَ دَرَجَٰتٖۚ وَٱللَّهُ بِمَا تَعۡمَلُونَ خَبِيرٞ ١١

“O you who have believed, when you are told, "Space yourselves" in assemblies, then make space; Allah will make space for you. And when you are told, "Arise," then arise; Allah will raise those who have believed among you and those who were given knowledge, by degrees. And Allah is Acquainted with what you do.”

# PROPHET MUHAMMAD (S.A.W)

“Acquire knowledge, because he who acquires it, in the way of the Lord, performs an act of piety; who speaks of it praises the Lord; who seeks it, adores God, who dispenses instruction in it, bestows alms; and who imparts it to its fitting objects, performs an act of devotion to God. Knowledge enables its possessor to distinguish what is forbidden from what is not; lights the way to Heaven; it is our friend in the desert, our companion in solitude, our companion, when bereft of friends; it guides us to happiness; it sustains us in misery; it is our ornament in the company of friends; it serves as an armor against our enemies. With knowledge the creatures of Allah rises to the heights of goodness and to noble position, associates with the sovereigns in this world and attains the perfection of happiness in the next.”

Mar. 12

# Computerized Weather Station

Project Report submitted to the
Department of Electrical Engineering, University of Management and Technology
in partial fulfillment of the requirements for the degree of
Bachelor of Science
in
Computer Engineering

(Ahmad Mobeen – 030120-005)

(15-03-2012)

# CERTIFICATE OF APPROVAL

It is certified that the work contained in this Project report, entitled

"COMPUTERIZED WEATHER STATION"

Was carried out by

Ahmad Mobeen 030120-005

Under the supervision of Mr. Saleem Ata for the partial fulfillment of the degree requirement of Bachelor of Science in Computer Engineering

Approved by

Mr. Saleem Ata
Advisor

# ABSTRACT

In this report, a computerized weather station is proposed. In this system, there are four mainly parts i.e. wind speed, wind direction, temperature & humidity which take as an input from the hardware and get output via computer. This hardware also shows result on LCD which is connected on hardware.

This report describes the different areas which are related to the project. A discussion of the project working as well as component selection and hardware implementation is also present in the report.

This system is very cheap. This system belongs to home based project. In this system, I choose four components for the simplicity. We choose other components like ground temperature (temperature of soil), air pressure (barometer), precipitation (rain gauge measures depth of water) and solar radiation (solarimeter).

This report indicates that how we forecast the weather with a simple home based project. We can make it more complex by implementation of different components as I mentioned above. This project is at low level. This project can be raised up to professional level. In this project, we can make different softwares or can add different softwares through which we can see weather conditions with different technical styles.

# DEDICATION

To our respected parents whose utmost love, care and struggle against all odds brought us to this height of knowledge with the blessings and help of ALMIGHTY ALLAH

# ACKNOWLEDGEMENTS

First of all, I am very grateful to ALMIGHTY ALLAH who gave me the strength to achieve my goals. Without HIS divine help, I could do nothing. Secondly, I would like to pay deep regard to my PARENTS who, with their selfless and extreme love, were always there to give me the required motivation, courage and confidence to complete my tasks. I would like to salute them because of their patience in managing with their busy routines and tight schedules. I am also extremely thankful to MR. SALEEM ATA, my project advisor, who gave me the desired knowledge and right direction to move forward. He was really cooperative through my complete voyage and provided me with each and every facility whenever and whatever was required for my project. He remained with me from the start till the end and though he used to be busy with his own work, he never refused my calls and whenever I wanted to meet him, he was there for my help. I also thanks to MY WIFE AND BOTH CHILDREN who care me and don't tease me in my project. I also thank to my elder brothers MR. KHALIL AHMAD and MR. KASHIF TOUQEER and also my younger brother MR BILAL AHMAD who helped me in this project. In the end, I am grateful to my friends who were always there to give me company whenever I was down on something. They created the right mix of work atmosphere in the university which led me to complete my project successfully. I would also like to thank MR. REHMAN who is the lecturer in virtual university for helping me endless discussions and fruitful suggestions.

## SIGNED BY:

**AHMAD MOBEEN** **030120-005** .....

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| CWOP | CITIZEN WEATHER OBSERVER PROGRAME |
| ICAO | INTERNATIONAL CIVIL AVIATION ORGANIZATION |
| ENSO | EI NINO SOUTHERN OSCILLATION |
| MAFOR | MARINE FORECAST |
| TXD | TRANSMIT DATA |
| RXD | RECEIVE DATA |
| DCE | DATA COMMUNICATION EQUIPMENT |
| DTE | DATA TERMINAL EQUIPMENT |
| GND | GROUND |
| DCD | DATA CARRIER DETECT |
| DTR | DATA TERMINAL READY |
| DSR | DATA SET READY |
| RTS | REQUEST TO SEND |
| CTS | CLEAR TO SEND |
| RI | RING INDICATOR |
| UART | UNIVERSAL ASYNCHRONOUS RECEIVER TRANSMITTER |
| EIA | ELECTRONIC INDUSTRIES ASSOCIATION |
| PSP | PARALLEL SLAVE PORT |
| BOR | BROWN OUT RESET |
| WDT | WATCHDOG TIMER |
| ICD | IN-CIRCUIT DEBUG |
| A/D | ANALOG TO DIGITAL |
| LED | LIGHT EMITTING DIODE |
| DC | DIRECT CURRENT |
| AC | ALTERNATING CURRENT |
| HR201 | HUMIDITY SENSOR |
| LM35 | TEMPERATURE SENSOR |
| PIC16F877A | MICROCONTROLLER |
| BBSs | BULLETIN BOARD SYSTEMS |
| SP2 | SERVICE PACK 2 |

FIGURE: COMPUTERIZED WEATHER STATION

# CHAPTER NO 1

# INTRODUCTION TO COMPUTERIZED WEATHER STATION

# 1.1 INTRODUCTION

A weather station is a facility, either on land or sea, with instruments and equipment for observing atmospheric conditions to provide information for weather forecasts and to study the weather and climate. The measurements taken include temperature, barometric pressure, humidity, wind speed, wind direction, and precipitation amounts. Wind measurements are taken as free of other obstructions as possible, while temperature and humidity measurements are kept free from direct solar radiation, or isolation. Manual observations are taken at least once daily, while automated observations are taken at least once an hour. Weather conditions out at sea are taken by ships and buoys, which measure slightly different meteorological quantities such as sea surface temperature, wave height, and wave period. Drifting weather buoys outnumber their moored versions by a significant amount.

# 1.2 INSTRUMENTS

Typical weather stations have the following instruments:

- Thermometer for measuring air and sea surface temperature
- Barometer for measuring atmospheric pressure
- Hygrometer for measuring humidity
- Anemometer for measuring wind speed
- Rain gauge for measuring liquid precipitation over a set period of time

In addition, at certain automated airport weather stations, additional instruments may be employed, including:

- Present Weather/Precipitation Identification Sensor for identifying falling precipitation
- Disdrometer for measuring drop size distribution
- Transmissometer for measuring visibility
- Ceilometers for measuring cloud ceiling

More sophisticated stations may also measure the ultraviolet index, solar radiation, leaf wetness, soil moisture, soil temperature, water temperature in ponds, lakes, creeks, or rivers, and occasionally other data.

# 1.3 EXPOSURE

Except for those instruments requiring direct exposure to the elements (anemometer, rain gauge), the instruments should be sheltered in a vented box, usually a Stevenson screen, to keep direct sunlight off the thermometer and wind off the hygrometer. The instrumentation may be specialized to allow for periodic recording otherwise significant manual labor is required for record keeping. Automatic transmission of data, in a format such as METAR, is also desirable as many weather stations' data is required for weather forecasting.

# 1.4 PERSONAL WEATHER STATION

A personal weather station is a set of weather measuring instruments operated by a private individual, club, association, or even business (where obtaining and distributing weather data is not a part of the entity's business operation). The quality and number of instruments can vary widely, and placement of the instruments, so important to obtaining accurate, meaningful, and comparable data, can also be very variable.

Today's personal weather stations also typically involve a digital console that provides readouts of the data being collected. These consoles may interface to a personal computer where data can be displayed, stored, and uploaded to Web sites or data ingestion/distribution systems.

Personal weather stations may be operated solely for the enjoyment and education of the owner, but many personal weather station operators also share their data with others, either by manually compiling data and distributing it, or through use of the Internet or amateur radio. The Citizen Weather Observer Program (CWOP) is one such, and the data submitted through use of software, a personal computer, and internet connection (or amateur radio) are utilized by the National Weather Service when generating forecast models, and by many other entities as well. Each weather station submitting data to CWOP will also have an individual Web page that depicts the data submitted by that station. The Weather Underground Internet site is another popular destination for the submittal and sharing of data with others around the world. As with CWOP, each station submitting data to The Weather Underground has a unique Web page displaying their submitted data.

# 1.5 DEDICATED SHIPS

A weather ship was a ship stationed in the ocean as a platform for surface and upper air meteorological observations for use in weather forecasting. It was also meant to aid in search and rescue operations and to support transatlantic flights. The establishment of weather ships proved to be so useful during World War II that the International Civil Aviation Organization (ICAO) established a global network of 13 weather ships in 1948. Of the 12 left in operation in 1996, nine were located in the northern Atlantic Ocean while three were located in the northern Pacific Ocean. The agreement of the weather ships ended in 1990. Weather ship observations proved to be helpful in wind and wave studies, as they did not avoid weather systems like merchant ships tended to and were considered a valuable resource. The last weather ship was MS Polar front, known as weather station M ("Mike") at 66°N, 02°E, run by the Norwegian Meteorological Institute. MS Polar front was removed from service January 1, 2010. Since the 1960s this role has been largely superseded by satellites, long range aircraft and weather buoys. Weather observations from ships continue from a fleet of voluntary merchant vessels in routine commercial operation.

# 1.6 DEDICATED BUOYS

Weather buoys are instruments which collect weather and ocean data within the world's oceans. Moored buoys have been in use since 1951, while drifting buoys have been used since the late 1970s. Moored buoys are connected with the ocean bottom using either chains, nylon, or buoyant polypropylene. With the decline of the weather ship, they have taken a more primary role in measuring conditions over the open seas since the 1970s. During the 1980s and 1990s, a network of buoys in the central and eastern tropical Pacific Ocean helped study the El Niño-Southern Oscillation. Moored weather buoys range from 1.5 meters (4.9 ft) to 12 meters (39 ft) in diameter, while drifting buoys are smaller, with diameters of 30 centimeters (12 in) to 40 centimeters (16 in). Drifting buoys are the dominant form of weather buoy in sheer number, with 1250 located worldwide. Wind data from buoys has smaller error than that from ships. There are differences in the values of sea surface temperature measurements between the two platforms as well, relating to the depth of the measurement and whether or not the water is heated by the ship which measures the quantity.

# 1.7 NETWORKS

A variety of land-based weather station networks have been set up globally. Some of these are basic to analyzing weather fronts and pressure systems, such as the synoptic observation network, while others are more regional in nature.

# 1.8 PROJECT SPECIFICATIONS

The aim of this project is to accomplish computerized weather station it takes signals as an input and give signals to hardware to access the signals and show on LCD as an output. This output also shows on computer via serial communication. my project is on the basic level. it will be able to control four devices which are attached to this hardware. However, it can be implemented on the large scale to control more sensors based upon the requirements.

# 1.9 TECHNIQUES

## 1.9.1PERSISTENCE

The simplest method of forecasting the weather, persistence, relies upon today's conditions to forecast the conditions tomorrow. This can be a valid way of forecasting the weather when it is steady state, such as during the summer season in the tropics. This method of forecasting strongly depends upon the presence of a stagnant weather pattern. It can be useful in both short range forecasts and long range forecasts.

## 1.9.2 USE OF A BAROMETER

Measurements of barometric pressure and the pressure tendency (the change of pressure over time) have been used in forecasting since the late 19th century. The larger the change in pressure, especially if more than 3.5 hPa (2.6 mmHg), the larger the change in weather can be expected. If the pressure drop is rapid, a low pressure system is approaching, and there is a greater chance of rain. Rapid pressure rises are associated with improving weather conditions, such as clearing skies.

## 1.9.3 LOOKING AT THE SKY

Along with pressure tendency, the condition of the sky is one of the more important parameters used to forecast weather in mountainous areas. Thickening of cloud cover or the invasion of a higher cloud deck is indicative of rain in the near future. At night, high thin cirrostratus clouds can lead to halos around the moon, which indicates an approach of a warm front and its associated rain. Morning fog portends fair conditions, as rainy conditions are preceded by wind or clouds which prevent fog formation. The approach of a line of thunderstorms could indicate the approach of a cold front. Cloud-free skies are indicative of fair weather for the near future. A bar can indicate a coming tropical cyclone. The use of sky cover in weather prediction has led to various weather lore over the centuries.

## 1.9.4 NOWCASTING

The forecasting of the weather within the next six hours is often referred to as nowcasting.In this time range it is possible to forecast smaller features such as individual showers and thunderstorms with reasonable accuracy, as well as other features too small to be resolved by a computer model. A human given the latest radar, satellite and observational data will be able to make a better analysis of the small scale features present and so will be able to make a more accurate forecast for the following few hours.

## 1.9.5 USE OF FORECAST MODELS

In the past, the human forecaster was responsible for generating the entire weather forecast based upon available observations. Today, human input is generally confined to choosing a model based on various parameters, such as model biases and performance. Using a consensus of forecast models, as well as ensemble members of the various models, can help reduce forecast error. However, regardless how small the average error becomes with any individual system, large errors within any particular piece of guidance are still possible on any given model run. Humans are required to interpret the model data into weather forecasts that are understandable to the end user. Humans can use knowledge of local effects which may be too small in size to be resolved by the model to add information to the forecast. While increasing accuracy of forecast models implies that humans may no longer be needed in the forecast process at some point in the future, there is currently still a need for human intervention.

## 1.9.6 ANALOG TECHNIQUE

The Analog technique is a complex way of making a forecast, requiring the forecaster to remember a previous weather event which is expected to be mimicked by an upcoming event. What makes it a difficult technique to use is that there is rarely a perfect analog for an event in the future. Some call this type of forecasting pattern recognition. It remains a useful method of observing rainfall over data voids such as oceans, as well as the forecasting of precipitation amounts and distribution in the future. A similar technique is used in medium range forecasting, which is known as teleconnections, when systems in other locations are used to help pin down the location of another system within the surrounding regime. Examples of teleconnections are by using El Niño-Southern Oscillation (ENSO) related phenomena.

- ✓ Analog model – A model based on similarities between the system under study and another system or process.
- ✓ Analytical model – A model that uses classic methods such as calculus or algebra to solve a series of equations.
- ✓ Conceptual model – A simplified representation of the system being examined.
- ✓ Continuous model – A model that uses continuous simulation, as opposed to a single-event model.
- ✓ Deterministic model – A model that produces the same output for a given input without consideration for risk or uncertainty.
- ✓ Empirical model – A model represented by simplified processes based on observation, measurements, or practical experience rather than solely on principles or theory. A lumped model is an example.
- ✓ Explicit model – A numerical model that uses parameter values or unknown variables at the beginning of a time step in the computational algorithms.
- ✓ Implicit model – A numerical model that uses parameter values or unknown variables at the end of a time step in the computational algorithms.
- ✓ Mass balance model – A model based on the conservation of mass and focuses on balancing inputs and outputs from the model area. Also known as a zero-dimensional model.
- ✓ Numerical model – A model that uses a numerical method to solve a series of equations, as opposed to an analytical model. The results from numerical models are often approximations, while analytic models produce exact solutions.
- ✓ One-dimensional model – A model that includes only one space dimension.
- ✓ Pseudo-deterministic model – A semi-distributed model.
- ✓ Stochastic mathematical model – A model that includes statistical elements and produces a set of outputs for a given set of inputs. The output represents a set of expected values.
- ✓ Two-dimensional model – A model that includes two space dimensions, usually horizontal and vertical averaging.

Most end users of forecasts are members of the general public. Thunderstorms can create strong winds and dangerous lightning strikes that can lead to deaths, power outages, and widespread hail damage. Heavy snow or rain can bring transportation and commerce to a stand-still, as well as cause flooding in low-lying areas. Excessive heat or cold waves can sicken or kill those with inadequate utilities, and droughts can impact water usage and destroy vegetation.

Several countries employ government agencies to provide forecasts and watches/warnings/advisories to the public in order to protect life and property and maintain commercial interests. Knowledge of what the end user needs from a weather forecast must be taken into account to present the information in a useful and understandable way. Examples include the National Oceanic and Atmospheric Administration's National Weather Service (NWS) and Environment Canada's Meteorological Service (MSC). Traditionally, newspaper, television, and radio have been the primary outlets for presenting weather forecast information to the public. Increasingly, the internet is being used due to the vast amount of specific information that can be found. In all cases, these outlets update their forecasts on a regular basis.

# 1.10 USES

## 1.10.1SEVERE WEATHER ALERTS AND ADVISORIES

A major part of modern weather forecasting is the severe weather alerts and advisories which the national weather services issue in the case that severe or hazardous weather is expected. This is done to protect life and property. Some of the most commonly known of severe weather advisories are the severe thunderstorm and tornado warning, as well as the severe thunderstorm and tornado watch. Other forms of these advisories include winter weather, high wind, flood, tropical cyclone, and fog. Severe weather advisories and alerts are broadcast through the media, including radio, using emergency systems as the Emergency Alert System which breaks into regular programming.

## 1.10.2 AIR TRAFFIC

Because the aviation industry is especially sensitive to the weather, accurate weather forecasting is essential. Fog or exceptionally low ceilings can prevent many aircraft from landing and taking off. Turbulence and icing are also significant in-flight hazards. Thunderstorms are a problem for all aircraft because of severe turbulence due to their updrafts and outflow boundaries, icing due to the heavy precipitation, as well as large hail, strong winds, and lightning, all of which can cause severe damage to an aircraft in flight. Volcanic ash is also a significant problem for aviation, as aircraft can lose engine power within ash clouds. On a day to day basis airliners are routed to take advantage of the jet stream tailwind to improve fuel efficiency. Aircrews are briefed prior to takeoff on the conditions to expect en route and at their destination. Additionally, airports often change which runway is being used

to take advantage of a headwind. This reduces the distance required for takeoff, and eliminates potential crosswinds.

## 1.10.3 MARINE

Commercial and recreational use of waterways can be limited significantly by wind direction and speed, wave periodicity and heights, tides, and precipitation. These factors can each influence the safety of marine transit. Consequently, a variety of codes have been established to efficiently transmit detailed marine weather forecasts to vessel pilots via radio, for example the MAFOR (marine forecast). Typical weather forecasts can be received at sea through the use of RTTY, Navtex and Radio fax.

## 1.10.4 AGRICULTURE

Farmers rely on weather forecasts to decide what work to do on any particular day. For example, drying hay is only feasible in dry weather. Prolonged periods of dryness can ruin cotton, wheat, and corn crops. While corn crops can be ruined by drought, their dried remains can be used as a cattle feed substitute in the form of silage. Frosts and freezes play havoc with crops both during the spring and fall. For example, peach trees in full bloom can have their potential peach crop decimated by a spring freeze. Orange groves can suffer significant damage during frosts and freezes, regardless of their timing.

## 1.10.5 FORESTRY

Weather forecasting of wind, precipitations and humidity is essential for preventing and controlling wildfires. Different indices, like the Forest fire weather index and the Haines Index, have been developed to predict the areas more at risk to experience fire from natural or human causes. Conditions for the development of harmful insects can be predicted by forecasting the evolution of weather, too.

## 1.10.6 UTILITY COMPANIES

Electricity and gas companies rely on weather forecasts to anticipate demand which can be strongly affected by the weather. They use the quantity termed the degree day to determine how strong of a use there will be for heating (heating degree day) or cooling (cooling degree day). These quantities are based on a daily average temperature of 65 °F (18 °C). Cooler temperatures force heating degree days (one per degree Fahrenheit), while warmer temperatures force cooling degree days. In winter, severe cold weather can cause a surge in demand as people turn up their heating. Similarly, in summer a surge in demand can be linked with the increased use of air conditioning systems in hot weather. By anticipating a surge in demand, utility companies can purchase additional supplies of power or natural gas before the price increases, or in some circumstances, supplies are restricted through the use of brownouts and blackouts.

## 1.10.7 PRIVATE SECTOR

Increasingly, private companies pay for weather forecasts tailored to their needs so that they can increase their profits or avoid large losses. For example, supermarket chains may change the stocks on their shelves in anticipation of different consumer spending habits in different weather conditions. Weather forecasts can be used to invest in the commodity market, such as futures in oranges, corn, soybeans, and oil.

## 1.10.8 MILITARY APPLICATIONS (UNITED STATES ARMED FORCES)

### 1.10.8.1 US NAVY

Similarly to the private sector, military weather forecasters present weather conditions to the war fighter community. Military weather forecasters provide pre-flight and in-flight weather briefs to pilots and provide real time resource protection services for military installations. Naval forecasters cover the waters and ship weather forecasts. The United States Navy provides a special service to both themselves and the rest of the federal government by issuing forecasts for tropical cyclone across the Pacific and Indian Oceans through their Joint Typhoon Warning Center.

### 1.10.8.2 US AIR FORCE

Within the United States, Air Force Weather provides weather forecasting for the Air Force and the Army. Air Force forecasters cover air operations in both wartime and peacetime operations and provide Army support; United States Coast Guard marine science technicians provide ship forecasts for ice breakers and other various operations within their realm; and Marine forecasters provide support for ground- and air-based United States Marine Corps operations. All four military branches take their initial enlisted meteorology technical training at Kessler Air Force Base. Military and civilian forecasters actively cooperate in analyzing, creating and critiquing weather forecast products.

Note: I take example of US ARMED FORCES but this weather forecasting instrument is present in every country's armed forces even in PAKISTAN.