Signalling System and Supervision of Wind Turbine Operation

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ABSTRACT - Recently, sustainable attention has been drawn to renewable energy sources. Wind and solar energy are considered as the most important sources for renewable energy. Wind energy systems as renewable source of energy have been extensively studied because of its benefits as an environmentally friendly clean energy, inexhaustible, safe and a low-cost for long term. Because of its unpredictable availability, power management control systems are essential to extract as much power as possible from the wind during its availability durations. This paper is motivated for proposing the main interface circuits for a control board of wind turbines. The Controller is involved in almost all decision-making processes in the safety systems in a wind turbine. At the same time it must oversee the normal operation of the wind turbine and carry out measurements for statistical use etc. The controller measures many parameters as analogue signals and also measures other parameters as digital signals. The proposed control board contains many interface circuits from several sensors located inside the turbine. The interface circuits design is determined depending on the nature of the output signals of the sensors, whether a change in voltage, current, resistance or frequency.

Keywords: wind turbine, operation , condition monitoring, pitch control, status checking, wind turbine sensosr

I. INTRODUCTION

Wind energy has been harnessed by many generations for thousands of years to mill grain, pump water and sailing [2]. Just in last decade, the wind energy industry has experienced a growth of almost 30 percent each year [1]. The controller measures the following parameters Voltage on all three phases, Current on all three phases, Frequency on one phase, Nacelle (Generator, Gear oil, Gear bearing) Temperature, Wind speed, the direction of yawing, High (Low) - speed shaft rotational speed as analogue signals [3, 4]. also measures the following parameters Wind direction, Over-heating of the generator, Hydraulic pressure level, Correct valve function, Vibration level, Twisting of the power cable, Emergency brake circuit, Brake-caliper adjustment, Centrifugal-release activation, Overheating of small electric motors for the yawing, hydraulic pumps, etc. as digital signals by several sensors[5]. A series of sensors measure the conditions and parameters in the wind turbine. Some of these parameters that are obviously interesting are not measured such as electrical power. The reason being that these parameters can be calculated from those is in fact measured. Power can thus be calculated from the measured voltage and current. These sensors are limited to those that are strictly necessary. Every single recorded measurement introduces a possibility for error. Internal supervision is applied on several levels. The controller is equipped with watchdogs control functions. These supervise that the controller does not make obvious calculation errors. The wind turbine software itself has extra control functions. the wind speed parameters in a wind turbine is designed to operate at wind speeds up to 25 m/s, and the signal from the anemometer is used in taking the decision to stop the wind turbine, as soon as the wind speed exceeds 25 m/s. As a control function of the anemometer the controller supervises wind speed in relation to power. The controller will stop the wind turbine and indicate a possible wind measurement error, if too much power is produced during a period of low wind, or too little power during a period of high wind. A wind measurement error could be caused by a fault in the electrical wiring, or a defect bearing in the anemometer. A constant functional check of the relationship between wind speed and power production ensures that it is almost impossible for the wind turbine to continue operation with a wind measurement error, and the possibility of a wind turbine being subject to stronger winds than its designed wind speed rating, is therefore more or less eliminated. Finally the controller lies in duplication of systems for more safety principle.

II. BACKGROUND

A. Wind Energy Conversion Principles

A wind turbine is a machine which converts the power in the wind into electricity. As electricity generators, wind turbines are connected to some electrical network [6]. The turbine consists of various large components or building blocks mounted together at site and resulting in a wind turbine system fig. 1 the main components of wind turbine. The rotor consists of the hub and blades of the wind turbine. These are often considered to be the turbine's most important components from both a performance and overall cost standpoint. The drive train consists of the other rotating parts of the wind turbine

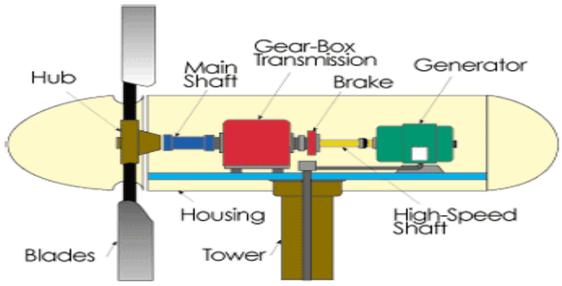

Figure1. The main components of wind turbine

downstream of the rotor. These typically include a low-speed shaft (on the rotor side), a gearbox, and a high-speed shaft (on the generator side). Other drive train components include the support bearings, one or more couplings, a brake, and the rotating parts of the generator. The purpose of the gearbox is to speed up the rate of rotation of the rotor from a low value (tens of rpm) to a rate suitable for driving a standard generator (hundreds or thousands of rpm). Nearly all wind turbines use either induction or synchronous generators. These designs entail a constant or nearly constant rotational speed when the generator is directly connected to a utility network. If the generator is used with power electronic converters, the turbine will be able to operate at variable speed. Nacelle and Yaw System includes the wind turbine housing, the machine bedplate or main frame, and the yaw orientation system. The main frame provides for the mounting and proper alignment of the drive train components. The nacelle cover protects the contents from the weather. This mechanism is controlled by an automatic yaw control system with its wind direction sensor usually mounted on the nacelle of the wind turbine.

B. Wind Turbine Controllers

The control system for a wind turbine is important with respect to both machine operation and power production. A wind turbine control system includes the following components Sensors, Power amplifiers, Actuators and Intelligence Controllers (computers, microprocessors). Controllers provide the connection between the measurement of an aspect of turbine operation and actions to affect that turbine operation. Typical controllers in a wind turbine include Mechanical mechanisms, Electrical circuits and Computers. Mechanical mechanisms can be used to control (motors, pistons, magnets and solenoids, blade pitch, yaw position, and rotor speed) Actuators. Electrical circuits provide a direct link from the output of sensors (speed, position, flow, temperature, current, voltage, etc. ;) to the desired control action. Sensor signals can be used to energize Power amplifiers (coils in relays or switches, electrical amplifiers, hydraulic pumps, and valves). Electrical circuits can also be designed to include a dynamic response to input signals from sensors in order to shape the total system dynamic operation. Computers are often used for controlling and mentoring operation. Computers can be configured to handle digital and analog inputs and outputs, and can be programmed to perform complicated logic and to provide dynamic responses to inputs. The control systems and sequence control of a wind turbine must primarily ensure its fully automatic operation. Any other approach requiring some manual intervention during normal operation would be entirely unacceptable from an economic standpoint[12].a supervisory and sequence control system is necessary for operation , condition, monitoring for early failure detection and controlling the operating sequence[13].The sequence controller receives external inputs according to the operating conditions, the wind conditions and the operator's intentions. This information will determine the set point values for the control system. The sequence controller monitors operating conditions and functional sequences and makes decisions concerning the mode of operation on the basis of logical deductions [11].

III. Wind Turbine Sensors

Sensors are an important part of Wind Turbine Control systems. On a large modern wind turbine, many sensors are used to communicate important aspects of turbine operation to the control system fig. 2 show the locations of the main sensor inside the Nacelle and the Hub. A sensor is a device that outputs a signal which is related to the measurement of (i.e. is a function of) a physical quantity. These measured variables

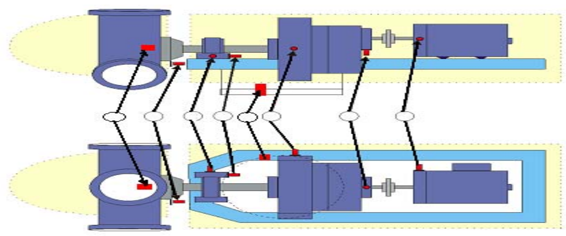

Figure2. The main sensor inside the Nacelle and the Hub in wind turbine

might include speeds (generator speed, rotor speed, wind speed, yaw rate, direction of rotation); temperatures (gearbox oil, hydraulic oil, gearbox bearing, generator bearing, generator winding, ambient air, electronic temperatures), Position (blade pitch, teeter angle, aileron position, blade azimuth, yaw position, yaw error, tilt angle, wind direction); Electrical characteristics (grid power, current, power factor, voltage, grid frequency, ground faults, converter operation); Fluid flow parameters (hydraulic or pneumatic pressures, hydraulic oil level, hydraulic oil flow); Motion, stresses, and strain (tower top acceleration, tower strain, shaft torque, gearbox vibration, blade root bending moment) and Environmental conditions (turbine or sensor icing, humidity, lightning or sounding). Sensors are used in the feedback loops and they provide information about the actual output of a plant. A speed sensor gives a signal proportional to the speed of a device and this signal is subtracted from the desired speed reference input in order to obtain the error signal. Sensors can be classified as analog or digital. Analog sensors are more widely available and their outputs are analog voltages. The output of an analog temperature sensor may be a voltage proportional to the measured temperature. Analog sensors can only be connected to a controller by using an A/D converter. Digital sensors are not very common and they have logic level outputs which can directly be connected to a computer input port. The choice of a sensor depends on many factors such as the cost, reliability, required accuracy, resolution, range and linearity of the sensor.The concepts of operation, the characteristics and the proposed interface for some of the popular sensors are discussed below.

A. Temperature Sensors

Temperature is one of the fundamental physical variables in most process control applications. Accurate and reliable measurement of the temperature is important in nearly all process control applications. Temperature sensors can be measured as analogue or digital value the proposed interface circuits for measuring Temperature as analogue, digital, value shown in fig. 3 and fig. 4 respectively. Some of the most commonly used analog temperature sensors are thermocouples, resistance temperature detectors (RTDs) and thermistors. Digital sensors are in the form of integrated circuits. The choice of a sensor depends on the accuracy, the temperature range, speed of response, thermal coupling, the environment (chemical, electrical, or physical) and the cost. The typical accuracy of a thermocouple is ±1 ◦C and of RTDs is ±0.2 ◦C.

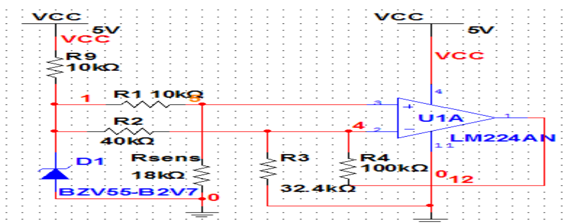

Figure 3. The proposed interface circuit for measuring Temperature as analogue value

There can be several sources of error during the measurement of temperature. Some important possible errors are Sensor self-heating, Electrical noise, Mechanical stress, Thermal coupling and Sensor time constant.

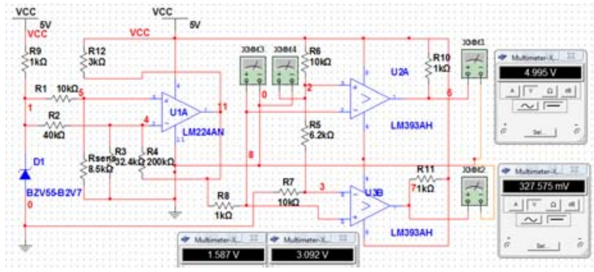

Figure 4. The proposed interface for measuring Temperature as digital value

B. Position sensors

Position sensors are used to measure the position of moving objects. These sensors are basically of two type's sensors to measure linear movement and sensors to measure angular movement. Potentiometers are available in linear and rotary forms. In a typical application a fixed voltage is applied across the potentiometer and the voltage across the potentiometer arm is measured. This voltage is proportional to the position of the arm, and hence by measuring the voltage we know the position of the arm. Fig. (5.a) shows a linear potentiometer. If the applied voltage is Vi , the voltage across the arm is given by (1). Where y is the position of the arm from the beginning of the potentiometer, and k is a constant. Fig. (5.b) shows a rotary potentiometer which can be used to measure angular position.

$$V_a = kV_i\, y \qquad (1)$$

If Vi is again the applied voltage, the voltage across the arm is given by (2). Where θ is the angle of the arm, and k is a constant. The proposed interface circuits for measuring dc voltage shown in fig. 6. Potentiometer type position sensors are

$$V_a = kV_i\, \theta \qquad (2)$$

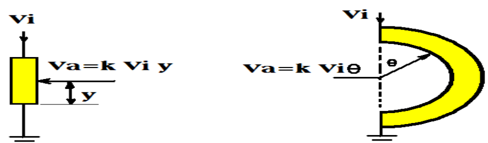

Figure 5. from lift to right (a) Linear and (b) Rotary potentiometer

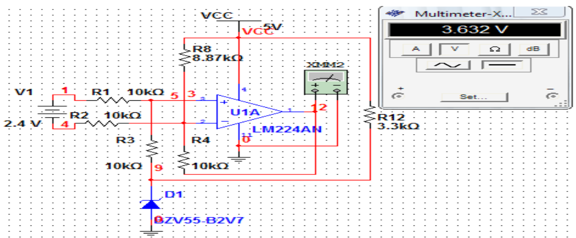

Figure 6. The proposed interface circuits for measuring dc voltage

low-cost, but they have the disadvantage that the range is limited and also that the sensor can be worn out by excessive movement of the arm. Among other types of position sensors are capacitive sensors, inductive sensors, linear variable differential transformers (LVDTs) and optical encoders.

C. WIND DIRECTION

The wind direction (vane) sensors used for indicating wind direction is one of the oldest meteorological instruments. Basically, a wind vane is a body mounted unsymmetrical about a vertical axis, on which it turns freely. The end offering the greatest resistance to the wind goes downwind or to the leeward [7]. The wind vane requires a minimum normal or perpendicular wind speed to initiate a turn. This minimum is called the starting threshold, and is typically between 0.5 and 1 m/s. Wind direction is usually measured at some distance from where the information is needed. The most convenient way of transmitting direction information is by electric cable so a mechanical position to electrical output transducer is required. One type of wind direction transmitter which works well for digital data systems is a potentiometer (a three terminal variable resistor), a voltage source Vi, and an analog to digital converter, as shown in Fig. 7. The potentiometer is oriented so the output voltage

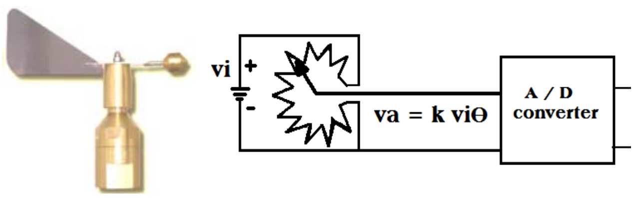

Figure 7. Wind direction sensors mechanical position to electrical output

Va is zero when the wind is from the north, Vi /4 when the wind is from the east, Vi /2 when the wind is from the south, etc. The A/D converter filters noise and converts Va to a digital form for recording. The potentiometer is usually wire-wound so Va changes in small discrete steps as the wiper arm rotates [8]. The A/D output always changes in discrete steps even for a smoothly varying input. These two effects make direction output resolutions of less than 3 degrees rather impractical, but such a resolution is usually quite adequate.

D. Air flow (Rotational Anemometer) sensors

Air flow is usually measured using anemometers. Anemometers, instruments that measure wind speed, have been designed in great variety [7, 9, 10]. Anemometer types include the propeller, cup, pressure plate, pressure tube, hot wire, Doppler acoustic radar, and laser. The propeller and cup anemometers depend on rotation of a small turbine for their output, while the others basically have no moving parts. A classical anemometer has a rotating vane, and the speed of rotation is proportional to the air flow. Anemometers may have an output voltage, either dc or ac, or a string of pulses whose frequency is proportional to anemometer speed. The ac converted to dc and use the same interface of dc the proposed interface circuits for measuring ac voltage show in fig. 8. The dc generator is perhaps the oldest type and is still widely used. The proposed interface circuits for measuring dc voltage described above in fig. 6 it requires no external power source and is conveniently coupled to a simple dc voltmeter for visual readout or to an analog-to-digital converter for digital use. The digital anemometer uses a slotted disk, a light emitting diode (LED), and a phototransistor to obtain a pulse train of constant amplitude pulses with

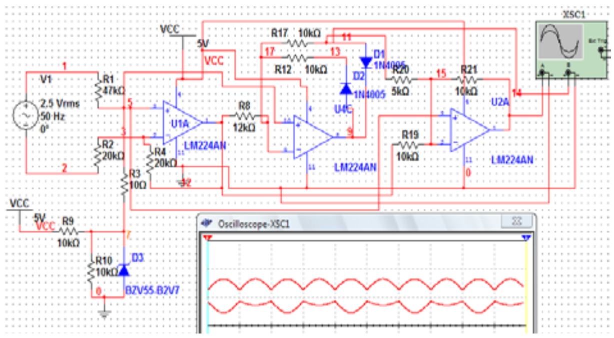

Figure 8. The proposed interface circuits for measuring dc voltage

frequency proportional to anemometer angular velocity. Wind speed can be determined either by counting pulses in a fixed time period to get frequency, or by measuring the duration of a single pulse. In either case, the noise immunity of the digital system is much better than the analog system. The cups turn a small dc generator which has a voltage output proportional to wind speed. The proportionality constant is such that for every 11.2 m/s increase in wind speed, the voltage increases by 1 volt. Fig. 9 shows a cup type anemometer Wind speeds below 1 m/s do not turn the cups so there is an offset in the curve of voltage versus wind speed, as shown in Figure (6).

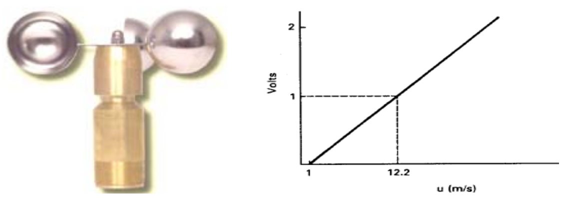

Figure 9. Classical anemometer

Since the straight line intercepts the abscissa at 1 m/s, an output voltage of 1 V is actually reached at 12.2 m/s. the wind speed u is given by (3); Where V is the output voltage. A visual indication of wind speed is obtained by connecting this dc generator to a dc voltmeter with an appropriately calibrated scale. The scale needs to be arranged such that the pointer

$$u = 11.2V + 1 \text{ m/s} \quad (3)$$

indicates a speed of 1 m/s when the generator is stalled and the voltage is zero. Then any wind speeds above 1 m/s will be correctly displayed if the scale is calibrated according to Fig. 6.

E. Velocity and acceleration sensors

Velocity is the differentiation of position, and in general position sensors can be used to measure velocity. The required differentiation can be done either in hardware using operational amplifiers or by the computer. For more accurate measurements velocity sensors should be used. There are two types of velocity sensors linear sensors, and rotary sensors. Linear velocity sensors can be constructed using a pair of coils and a moving magnet. When the coils are connected in series the movement of the magnet produces additive voltage which is proportional to the movement of the magnet. The tachometer (or tachogenerator) is one of the most widely used rotary velocity sensors. A tachometer shown in Fig. (10.a) is connected to the shaft of a rotating device and produces an analog d.c. voltage which is proportional to the speed of the shaft. If ω is the angular velocity of the shaft, the output voltage of the tachometer is given as in (4). Where k is the gain constant of the tachometer. Another popular velocity sensor is the optical encoder. This basically consists of a light source

$$Vo = k\omega, \quad (4)$$

and a disk with opaque and transparent sections where the disk is attached to the rotating shaft. A light sensor at the other side of the wheel detects light and a pulse is produced when the transparent section of the disk comes round. The encoder's controller counts the pulses in a given time, and this is proportional to the speed of the shaft. Fig. (10.b) shows a typical commercial encoder. Acceleration is the differentiation of velocity or the double differentiation of position. Thus, in general, position sensors can be used to measure acceleration. The differentiation can be done either by using operational amplifiers or by a computer program. For accurate measurement of the acceleration, semiconductor accelerometers can be used.

Figure 10. From lift to right (a) commercially available tachometer and commercially available encoder

F. Force sensors

Force sensors can be constructed using position sensors. Alternatively, a strain gauge can be used to measure force accurately. There are many different types of strain gauges. A strain gauge can be made from capacitors and inductors, but the most widely used types are made from resistors. A wire strain gauge is made from a resistor in the form of a metal foil. The principle of operation is that the resistance of a wire increases with increasing strain and decreases with decreasing strain. In order to measure strain with a strain gauge it is connected to an electrical circuit and a Wheatstone bridge is commonly used to detect the small changes in the resistance of the strain gauge. Strain gauges can be used to measure force, load, weight pressure, torque or displacement. Force can also be measured using the principle of piezoelectricity. A piezoelectric sensor produces voltage when a force is applied to its surface.

G. Pressure sensors

Early pressure measurement was based on using a flexible device (e.g. a diaphragm) as a sensor; the pressure changed as the device moved and caused a dial connected to the device to move and indicate the pressure. Nowadays, the movement is converted into an electrical signal which is proportional to the applied pressure. Strain gauges, capacitance change, inductance change, piezoelectric effect, optical pressure sensors and similar techniques are used to measure the pressure.

H. Liquid sensors

There are many different types of liquid sensors. These sensors are used to detect the presence of liquid; measure the level of liquid and measure the flow rate of liquid. The presence of a liquid can be detected by using optical, ultrasonic, change of resistance, change of capacitance or similar techniques. Optical technique is based on using an LED and a photo-transistor, both housed within a plastic dome and at the head of the device. When no liquid is present, light from the LED is internally reflected from the dome to the photo-transistor and the output is designed to be off. When liquid are present the dome is covered with liquid and the refractive index at the dome–liquid boundary changes, allowing some light to escape from the LED. As a result of this, the amount of light received by the photo-transistor is reduced and the output is designed to switch on, indicating the presence of liquid.

IV. WIND TURBINE MENTORING

Also there are some important measurements for mentoring the output of wind turbine such as measuring of the output AC voltage and measuring the DC voltage in intermediate stage before converting it to AC in the output. The proposed interface circuits for measuring high tension Dc voltage and Ac voltage are shown respectively in fig. 11, fig. 12 and fig.13.

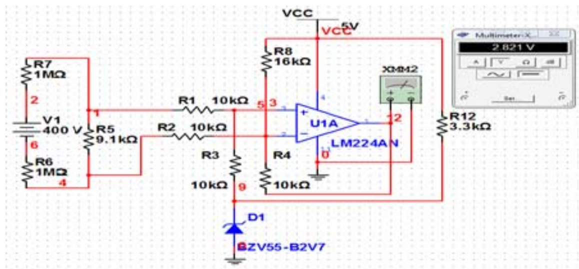

Figure 11. The proposed interface circuits for measuring high tension Dc voltage

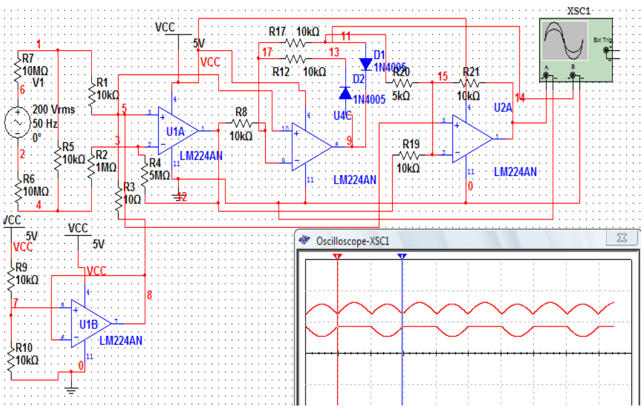

Figure 12. The proposed interface circuits for measuring Ac voltage without o/p filter

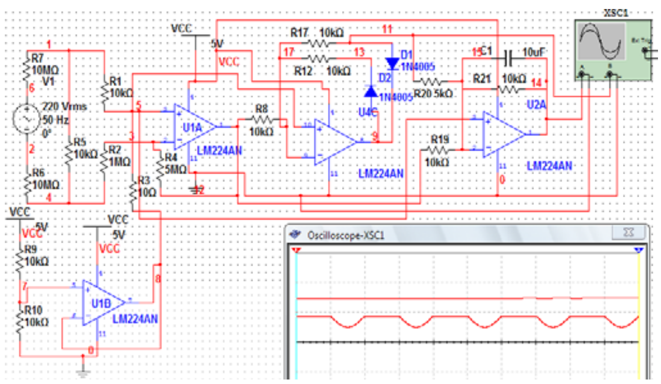

Figure 13. The proposed interface circuits for measuring Ac voltage with o/p filter

V. CHECK STATUS ALGORITHM DESIGN

After the determination of all parameters required for the safety starting and the operation under control of the wind turbine .The required algorithm to check the status of these parameters can then be formulated as follow.

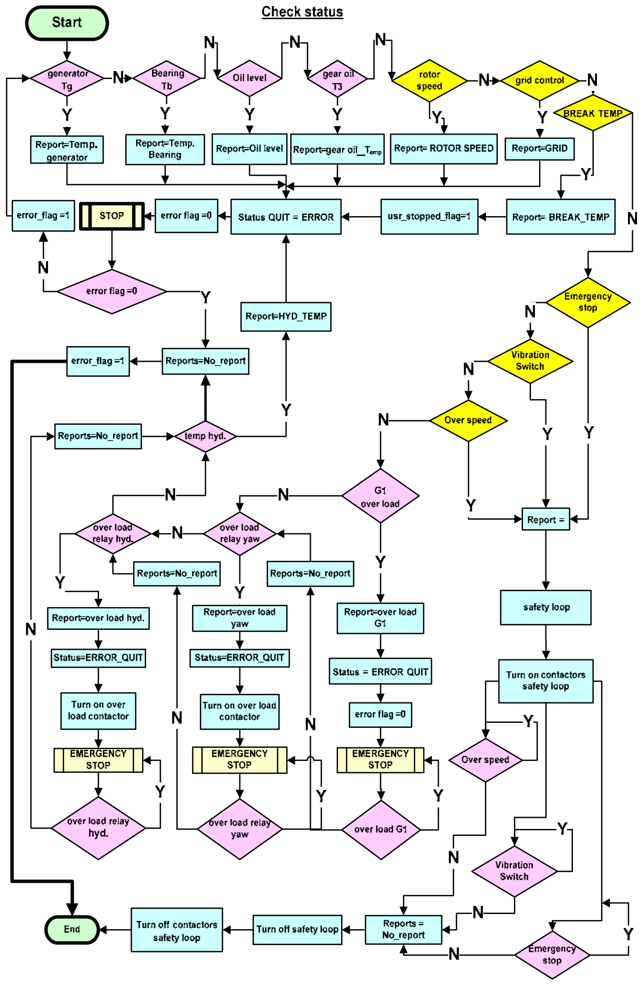

Figure 14. The proposed check status algorithm

VI. RESULTS

All the previous interface circuits successfully tested separately and then brought together into the main control board. The range of temperature interface circuits as analogue value is from 0 to 3.5 volts represent temperatures from (0) to (70) °C and the degree of accuracy of 0.05 volts per degree Celsius. The temperature interface circuits as digital indicate the normal range of operation from (37) to (60) °C, Fig. 15 shows testing result of the temperature interface circuits. The check status Algorithm that is designed to work before starting and during operation of the turbine was tested in the lab, the wind turbines. Turbine does not begin normal operation not only when it is in the face of wind and wind speed equivalent to 3m/s depending on (according to) the signal from the anemometer but also there is no indication to errors from any sensors in the turbine. Nacelle is directed automatically to meet the wind (yawing) and the wind turbine continues to face the wind according to the wind direction (vane) sensor signal at higher turbine. Also removed the era of cable automatically (twist cable), some other functions was tested manually, such as, control the angle of opening blade (from angle 2° to 90°),

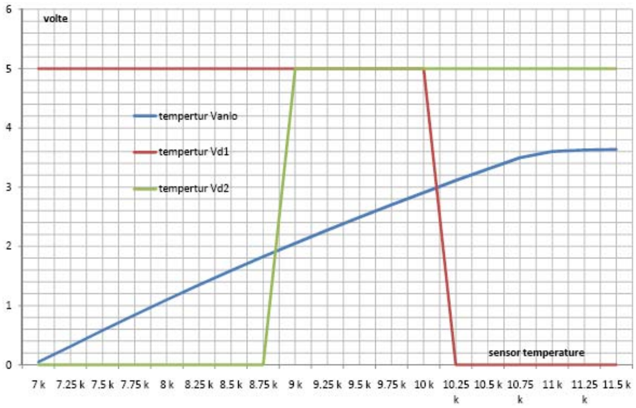

Figure 15. The result of interface circuit of measuring the temperature

The normal stop and emergency shutdown of the turbine and the response of turbine to error insertion by stop or show error message related to the mentored sensor signal. Finally the wind turbine is automatically stopped at the arrival of signal cables to the era then the controller directs the Nacelle (YAW) in the opposite direction to rise the twisting of the cables.

VII. Conclusion

The proposed interface circuits and the check status algorithm have been developed to maintain the system at its highest possible efficiency by increasing security measures against the occurrence of internal errors. So it is best to build a system with few components as possible. It is also possible to build-in an internal automatic self-supervision, allowing the controller to check and control its own systems. Another feature of the proposed interface circuits is that it can be easily customized for various wind turbines machines since it is independent of turbine characteristics. The proposed algorithm uses a modified version of an algorithm that tested on 20 kW and 100 kW wind turbine . The proposed interface circuits and the check status algorithm have gleaned insight into the practical considerations of design control systems for wind turbines. A distinction has been made between supervisory and safety control and separate control issues identified. Common control systems and methods for implementation of these systems in modern wind turbines have been examined. The approach to controlling a wind turbine may vary but the primary objectives remain the same.

References

[1] “Global wind 2006 report,” June 2007.

[2] T. I. of Electrical and E. E. Inc, "Mathematical and Computational Applications," IEEE Canadian review: Green power, pp. 10–17, December 2007.

[3] O.H.Abdel Satar, Saad.M.A.Eid, E.M.Saad and R.R.Darwish, " Control Logic Algorithm for Medium Scale Wind Turbines," IJCSI , ISSN (Online): 1694-0814,Vol. 9, Issue 1, No 2, January 2012.

[4] O.H.Abdel Satar, Saad.M.A.Eid, E.M.Saad and R.R.Darwish, " Efficient Control Logic Algorithm for Wind Turbine," IEEE , 29th NRSC 2012, 10-12 April 2012, Faculty of Engineering/Cairo University, Egypt.

[5] Rules and Guidelines Industrial Services , *"Guideline for certification of wind turbine*," Germanischer Lloyd WindEnergie GmbH-2003.

[6] O.H.Abdel Satar, Saad.M.A.Eid, E.M.Saad and R.R.Darwish, " Adaptive and Reliable Control Algorithm for Hybrid System Architecture" IJCSI , ISSN (Online): 1694-0814,Vol. 9, Issue 1, No 2, January 2012.

[7] Golding, E." The Generation of Electricity by Wind Power," Halsted Press, New York,1976.

[8] Johnson, G.L., “Measuring Wind Speed Profiles with Balloons,” Wind Energy Technology Conference, Kansas City, Missouri, March 16, 17, 1981.

[9] Middleton, W., E. Knowles, and A.F. Spilhaus, "Meteorological Instruments," 3rd. ed.,University of Toronto Press, Toronto, 1953.

[10] Noll, K.E. and T.L. Miller, "Air Monitoring Survey Design," Ann Arbor Science Publishers, Ann Arbor, 1977, pp. 215-237.

[11] Erich hau "Wind turbines, Fundamentals, Technologies, Applications , Econmice," 2005.

[12] BMFT report, Kleinkauf,W, Leonhard,W. ," Betriebsverhalten vonWind energieanlagen, Gesamthochschule Kassel," Institut fürElektrische Energieversorgungssysteme und Technische Unive Braunschweig, Institut für Regelungstechnik, No 03E-4362-A, 1982.

[13] T.W. Verbruggen ,"Wind Turbine Operation & Maintenance based on Condition Monitoring WT-Ω," April 2003 ECN-C--03-047

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