Smart Humidity Monitoring System for Infectious Disease Control

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***Abstract*—Relative humidity of a room plays an important role in the well being of the occupants of the room. Relative humidity also play an important role in spread of infectious diseases. Relative humidity is the deciding factor which makes the virus active or inactive. Our work has considered this parameter humidity which may look inconspicuous, but plays an important role in our wellbeing of human beings. Our work considers the positive effects of maintaining humidity and has developed a sensor based IoT module which monitors the relative humidity of a room and updates the status to the occupants of the room. The system also controls the AC and Humidifier in the room to maintain optimum humidity levels ranging from 45%- 55%.The developed module is a cost effective solution which can be very beneficial in hospitals because the risk of infectious disease outbreak is high in such places.**

Keywords—humidity;sensor;IoT;health;network;

I. INTRODUCTION

Many studies show that relative humidity plays a vital role in spread of infectious diseases. These studies were simulated by flu transmission .This was done by using coughing and breathing models. The cough models released the virus whereas the breathing models captured the particles. The collected particles were then tested on their ability to affect human beings.

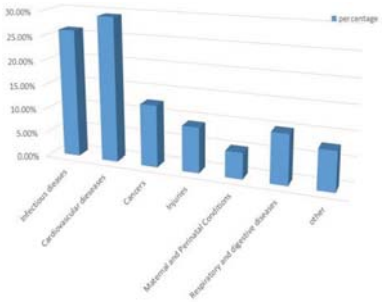

Fig.1.Statistics of death due infectious disease

After testing it was found that at 23 percentage humidity about 75 percent of the virus particles were active enough to cause infections. Most of these flu particles became inactive about fifteen minutes after they were released, when humidity levels were increased to 43 percent. However humidity cannot be very high as mold can grow [1].Statistics worldwide show that infectious disease is the second biggest factor contributing to deaths worldwide as shown inFig.1 [2]. Studies also show that there is close connection between spread of dengue and humidity [3]. Statistics and studies have shown that the optimum relative humidity level can range between 45 and 55%.In such an environment infectious diseases are less prevalent as shown in Fig.2. [4]

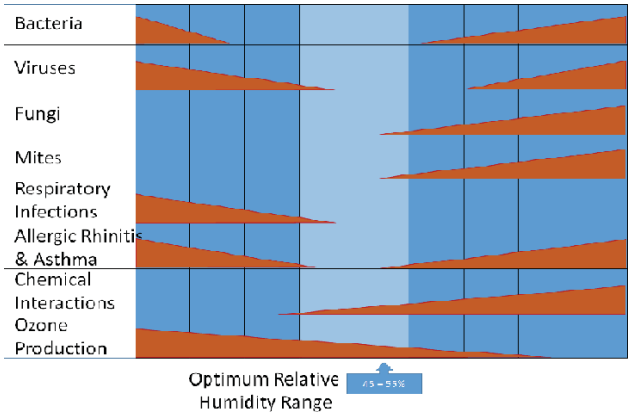

Fig.2.Infectious disease vs Humidity

This work takes into consideration the close relationship between infectious disease and humidity and has proposed a solution which can maintain relative humidity of a room thereby controlling outbreak of infectious diseases. Such a system can be very useful at hospitals where the probability of an infectious outbreak is huge. The propose system is very cost effective and can also be employed in schools, work places and homes. The proposed system is a sensor basedhardware module which monitors the relative humidity of air and transmits the information to the user in the particular room or even a remote location via internet. The module can also be programmed to maintain relative

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humidity levels in a room depending on the user's requirement. The humidity level is maintained by controlling the AC and the humidifier which is present in the particular location. This system can be very effective in closed environments

II. PROPOSED SYSTEM

A. Block diagram

The block diagram of the proposed the system is shown in Fig.3.The proposed system gets inputs from the humidity sensor. The sensor used for the prototype is a digital sensor and the inputs are directly fed into the processor without any signal conditioning. The algorithm in the processor compares the input humidity and takes action based on whether the humidity is below or above nominal levels. The relative humidity percentage is also displayed on the LCD display. The same information is transmitted through WIFI module over the internet to a server. This information can be accessed even from a remote location.

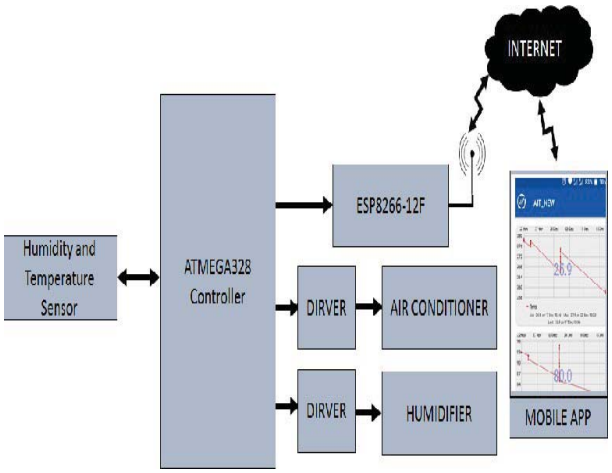

Fig.3.Block Diagram of Proposed system

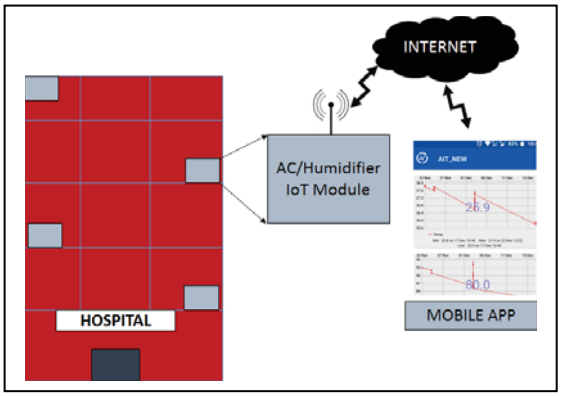

Fig.4.Use case of proposed system

The use case diagram is propose for a hospital environment.The module can also be used in work places, homes and schools. The use case of the proposed system is shown in Fig.4.

A. Experimental Setup

The proposed system was developed using the ATMEGA328. The prototyped system setup is shown in Fig 5.For the built prototype the inputs are acquired from the DHT22 temperature and humidity sensor. The acquired inputs are transferred using single wire communication protocol to the ATMEGA328.

These inputs are given to the humidity monitor and control algorithm which compares the acquired values with the nominal humidity range values.

If the input values are not in the nominal range corrective action in terms of controlling humidifier or AC is taken. The details regarding relative humidity are also transmitted to a remote server through the (ESP8266-12F) IEEE 802.11. This information is also available locally through the CLCD display. This information can also be accessed through a mobile app.

I. RESULS AND DISCUSION

A. Testcase

The humidity monitor and control module was prototyped and tested. The module was validated using various test cases Test case-1: Sensor data acquisition

Test case-2: Processing data

Test case-3: Transmission of data over internet

Test case-4: Display of relative humidity locally on CLCD Test case-5: Data display on an IoT analytics platform

Test case4 of proposed system in shown in Fig.6. Test case5 of proposed system in shown in Fig.7.

Fig.6. Test case4

III. Conclusion

The humidity monitoring and control module which can prevent an infectious disease outbreak and also help in the wellbeing of human beings was designed and prototyped. The humidity parameters were taken as input and the control was initiated. In the prototype a fan was used instead of the AC and a small motorized water sprayer was used as the humidifier.

Although there are large number of systems which monitor humidity very few has considered the perspective of humidity monitoring for infectious diseases. But this prototype has to be tested in a real laboratory for actual impact of relative humidity on each and every infectious disease spreading organism.

This prototype can be lifesaving because statistics confirm that death due to infectious disease contribute a huge percentage worldwide. The module has to be optimized and its reliability has to be improved for various infectious diseases. The propose system also is an IoT based solution. Therefore the information regarding the relative humidity can be monitored and controlled remotely.

For example if the doctor recognizes an outbreak of a particular disease he can control the humidity to be maintained in the room even when he is at a remote location. Thus this module is a simple and cost effective module which can be placed anywhere for the general wellbeing of people.

IV. Future work

The developed module can further be optimized for accuracy by testing the same in a laboratory setup where transmission of virus is simulated. If the prototype is tested in actual infectious environments then the exact level of humidity to be set can be verified.

The prototype can further be enhanced by studying different types of infectious diseases and the relative humidity at which they become inactive. Thus the module can also maintain humidity specific to a particular infectious organism.

Acknowledgment

The authors would like to thank Er.C.Sukumaran for his constant encouragement. Special thanks for providing sophisticated laboratory facilities, for carrying out this work. The authors would like to thank Dr.N.Kathiravan for his unconditional support during the design and development of the proposed system.

REFERENCES

[1] Rachael Rettner, ' Higher Humidity Lowers Flu Transmission 'February27,2013.[Online].Available transmission-humidity.html [Accessed: 3- Dec- 2018].

[2] Ami Shah, Thomas Savage ' Math and Medicine: Modeling Transmission of Infectious Disease'.[Online].Available https://sites.google.com/a/scarletmail.rutgers.edu/introduction-to- infectious-disease-modeling-for-medical-students/home [Accessed: 3- Dec- 2018].