IoT Based Detection Of Snoring event For the Treatment of Obstructive Sleep Apnea

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Abstract— ***Obstructive sleep Apnea (OSA) is a most common sleep-related breathing disorder.OSA affects the people mainly in the age of 30 to 70.In current population, the percentage of the disorder gets increased and death rate also increases which is one of the under diagnosed and under treated disorder.***

In our project, we introduces a low cost, low power, wearable wireless device to diagnose and treat obstructive sleep apnea. The developed device uses to detect snoring event. When a snoring event is detected, the electrical stimulator delivers a small amount of electric current to throat muscles (pharyngeal muscle) to regain their normal muscle action, thus treating obstructive sleep apnea. And also it sends message followed by phone call to the consulting doctor through IoT. The patient data can be stored in cloud and can be used to future diagnosis

Index Terms— **Sleep apnea, Obstructive sleep apnea, IoT, Electrical stimulator, Pharyngeal Muscle**

I. INTRODUCTION

Sleep apnea is an involuntary stoppage of breathing during sleep. By a narrowing of the upper airway apneas occurs or breathing stops. The "**apnea**" literally means "**without breath**". There are mainly three types of sleep apnea

i) Obstructive Sleep Apnea
ii) Central Sleep Apnea
iii) Mixed Sleep Apnea

Obstructive Sleep Apnea is the most common type of sleep apnea, it is a condition in which breathing stops involuntarily for brief period of time during sleep. Generally, the air flows evenly from the mouth and nose into the lungs at all times. In OSA, the normal flow of air is frequently stopped throughout the night. The passage of air breaks because airway space in the area of the throat is extremely narrow.

Obstructive sleep apnea happens when the muscles in the back of the throat relax very much to permit the normal breathing. These muscle support structures involving the (back of the roof of the mouth) soft palate, the triangular piece of tissue hanging from the soft palate (uvula) and the tonsils and tongue. When the muscles relax, the airway narrows are closes as the breath in and breathing may be insufficient for 10 seconds or lengthy. This lead to lower the level of oxygen in the blood and cause an increase of carbon dioxide in blood.

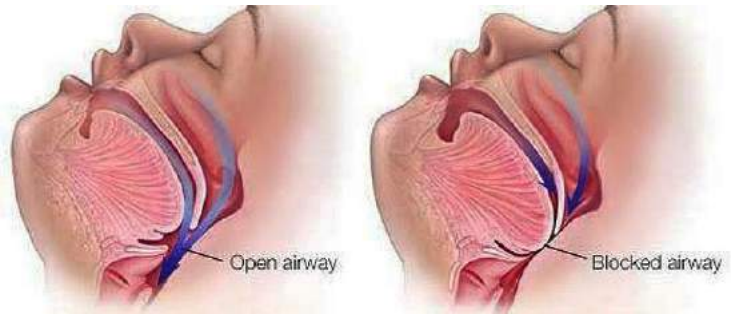

Fig.1.Normal Breathing Sleep Apnea

A salient sign

of obstructive sleep apnea is snoring. Snoring is the harsh sound that occurs when air passes past relaxed tissues in the throat, causing the tissue to vibrate as the breath.

The pharyngeal muscles are play an important role in respiratory function. Poor pharyngeal muscle receptiveness during sleep is another physiologic feature contributing to OSA. Insufficient receptiveness of the upper airway dilator muscles during sleep is esteemed by minimal increase in EMG activity to negative pharyngeal pressure..

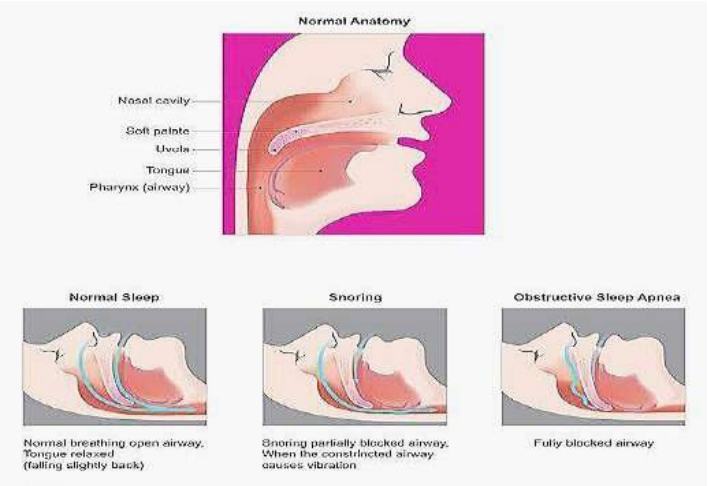

Fig.2.Snoring and OSA

Feedback for immediate pressure adjustments in Continuous Positive Airway Pressure (CPAP) devices is another issue in which the real-time monitoring for OSA is highly welcome, as is also the context for other associated medical treatments.

II. STATEMENT OF PROBLEM

The detection of snoring events for the treatment of obstructive sleep apnea using IoT

III. OBJECTIVE OF THE PROJECT

The following are the objective of the project:

To detect the snoring event using sound sensor

Stimulate the pharyngeal muscle to resume the normal breathing by an Electrical stimulator

Save the data in cloud and also send message to the consulting doctor followed by phone call alert.

IV. METHODOLOGY

Block Diagram

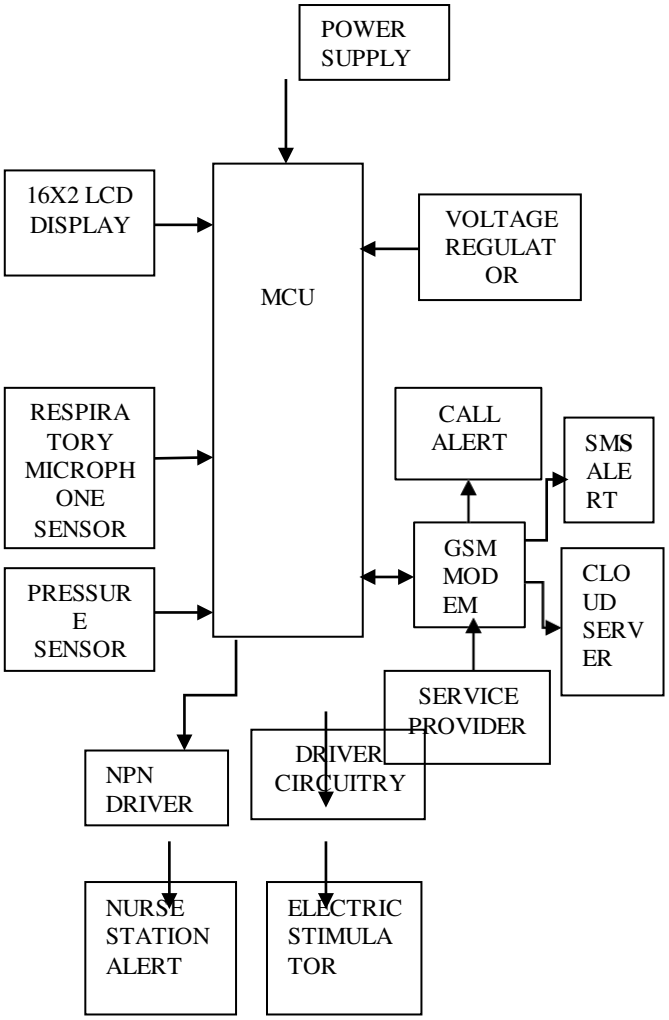

Fig.3.Block Diagram

Power Supply

The 220V alternating current is converted into 12V direct current by using the step-down transformer and Full-wave Bridge rectifier.

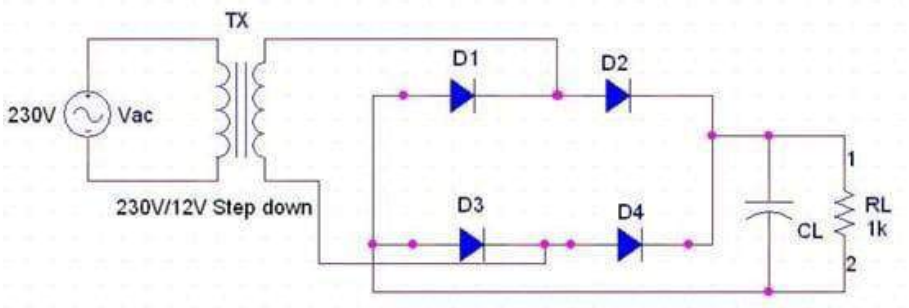

Fig.4.Power Supply

Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, 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. Arduino Uno has a number of facilities for communicating with a computer, another Arduino board, or other microcontrollers.

Voltage Regulator

A regulated power supply is very much essential for several electronic devices due to the semiconductor material employed in them have a fixed rate of current as well as voltage. The device may get damaged if there is any deviation from the fixed rate. The AC power supply gets converted into constant DC by this circuit. By the help of a voltage regulator DC, unregulated output will be fixed to a constant voltage. The circuit is made up of linear voltage regulator 7805 along with capacitors and resistors with bridge rectifier made up from diodes. From giving an unchanging voltage supply to building confident that output reaches uninterrupted to the appliance, the diodes along with capacitors handle elevated efficient signal conveyal.

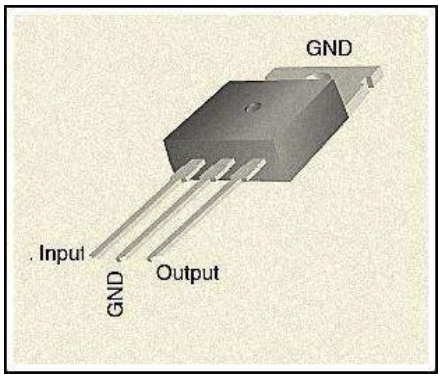

Fig.5.7805IC

LCD Display

This is an LCD Display designed for E-blocks. It is a 16 character, 2-line alphanumeric LCD display connected to a single 9-way D-type connector. This allows the device to be connected to most E-Block I/O ports. The LCD display requires data in a serial format, which is detailed in the user guide below. The display also requires a 5V power supply. Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc

Sound sensor

The sound sensor is used to detect the respiration and snoring events. It is typically a microphone, which contain diaphragm. The diaphragm vibrates when it senses any sound. It's working voltage is 3.3 to 5V.

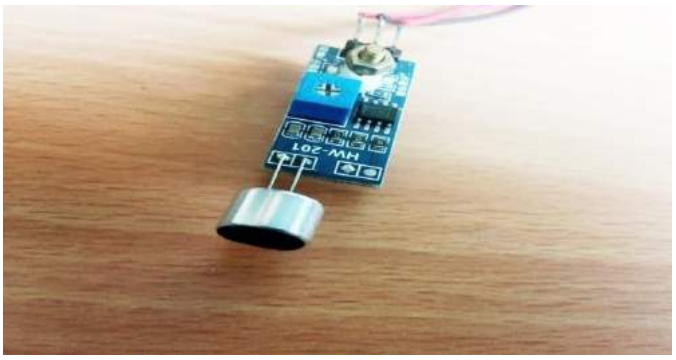

Fig.6.Sound sensor

GSM Modem

This GSM Modem can work with any GSM network operator SIM card just like a mobile phone with its own unique phone number. Advantage of using this modem will be that its RS232 port can be used to communicate and develop embedded applications.

The SIM800C is a complete Dual-band GSM/GPRS solution in a SMT module featuring an industry-standard interface, the SIM800CS is a quad-band GSM/GPRS module that works on frequencies GSM850MHz, delivers performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption.

Fig.7.GSM Modem

V. RESULT

In our proposed system, we designed a method to detect snoring event by sound sensor. When snoring started the diaphragm inside the sound sensor vibrates and it generates electric signal and it given to the Microcontroller Unit. When a snoring event is detected the electrical stimulator delivers a small amount of electric current to the pharyngeal muscle of the throat. The system records the snoring events continuously. If the snoring doesn't stops, a text message sends to the consulting doctor's mobile phone through the GSM Modem.
The following diagram shows our proposed model(Fig.6)

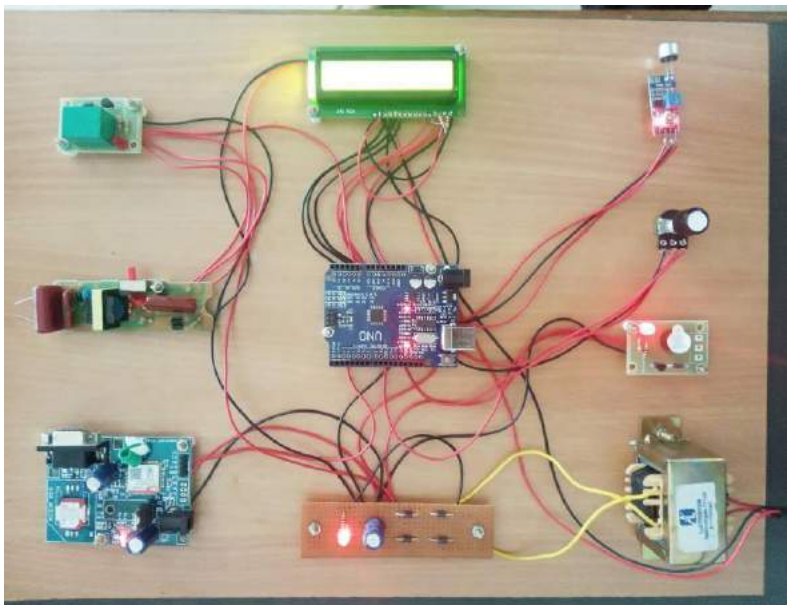

Fig.8.Proposed System

The system is IoT based and it deliver a text message to the consultant doctor. The message contain a weblink, it contain the snoring event and blood pressure of the patient.

(a) (b)

Fig.9.(a) & (b) Graph contains the Snoring event V/S Date & Blood Pressure V/S Date

V.CONCLUSION

In this project work, an attempt to design a non-invasive device to detect the snoring events for the treatment of obstructive sleeps apnea. From the project we conclude that :

- Sleep Apnea is a ordinary disturbance with many effects on sleep and daytime functioning. Obstructive sleep apnea is linked to many important adverse daytime consequences such as heart disease, stroke, insulin resistance and hypertension.
- In current population, the ratio of this disorder gets increased and death rate also increases.
- So the treatment of obstructive sleep apnea is important for future
- This proposed method is non-invasive, low cost, low power, and wearable device.
- And it is applicable in the areas like home care, medical centres, and medical institutions and tele-health applications.
- The patient data is stored in the IoT cloud for future treatment and other research studies.
- IoT does not have any range limit so that, doctor can prescribe treatment at any location through tele-communication.
- Our project reveals the use of INTERNET OF THINGS (IoT), which exhibit many of the characteristics desirable for high performance pavement applications, including data breach, easy access, high speed, complexity, better time management and adapting to new standards.

Future Development

In our proposed system we considered the two causes of obstructive sleep apnea(snoring, blood pressure). This is a non invasive wearable device and it can be used in home care, hospitals, medical institutions. In hardware part we used sound sensor and pressure sensor. For future development can be use temperature sensor, muscle sensor and sensors to detect other patient data like ECG, EMG e.t.c.

In software, we used Arduino IDE to program the Arduino Uno board. When the snoring event is detected a message and call alert is send to the doctor's phone. It can be modified into adding another person's phone number to convey the patient condition.

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