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DIAGNOSIS OF LIVER CIRRHOSIS USING AMMONIA AS BIOMARKER IN HUMAN BREATH

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ABSTRACT: - This project is to design and develop a non-invasive method to diagnose liver cirrhosis which is also called as hepatic Cirrhosis. It is a disease in which the healthy liver tissues get affected severely and it gets replaced with scar tissues. It is a late-stage disease and it causes about 26000 deaths yearly in the US. One in 400 adults get affected with this disease in the US. Hence it is necessary to diagnose the disease earlier, so that we can prevent the patient from suffering. It can be done using a technique called breath analysis. Breath analysis is a technique in which the diseases in human beings can be diagnosed using human breath. Human breath naturally consists of over 3500 Volatile Organic Compounds (VOC) other than that of major gases like oxygen, nitrogen and carbon dioxide. Each VOC is a biomarker to various diseases and metabolism of our body. Likewise, ammonia is one of the 3500 VOCs and it is a biomarker to liver cirrhosis. Hence the measurement of ammonia in human breath leads to the detection of liver cirrhosis. The normal range of ammonia gas in our breath is 0.5 ppm. The main advantage of this project is the non-invasive way of detecting cirrhosis which does not involve any pain staking invasive laboratory methods

I.INTRODUCTION

Liver is the largest organ present in the human body. It is one of the important parts of the body which performs the essential role in regulating the supply of glucose by adding and removing the substances in the blood. It also helps in the process of digestion by producing the bile fluid. Thus, the liver and blood have close connections. It also secretes various biological compounds to ensure the health of humans. One of the major functions of the liver is detoxification. It removes the wastes and converts urea into urine along with the kidneys.

Cirrhosis is a complication part of liver disease which involves the damage of the liver cells. The bonding of the liver and blood is destroyed by cirrhosis. Liver inflammation occurs in early stage of human life and if it is not treated properly it leads to fibrosis. Further if it is not treated, it leads to cirrhosis which is the last stage of the liver damage. Hence it is essential to detect the disease earlier and to undertake the necessary treatment in order to cure it. Otherwise, it causes serious impact on patient's health and finally it leads to death. As the liver performs many necessary functions in the body, it is essential to maintain it in a healthy manner. Human breath analysis is a very promising field for disease diagnosis. There are about over 3500 Volatile Organic Compounds present in our exhaled breath, one of such VOC is ammonia. The VOC's contained in human breath are detected with the help of the sensors.

It is found that ammonia acts as the biomarker for liver cirrhosis. By detecting and mapping the concentration of ammonia present in the exhaled human breath we can observe the prior stages of the disease. This can be done with the help of breath analysis technique. By mapping the concentration of ammonia and diagnosing with the standard values we can ensure that the patient is affected with cirrhosis or not. Detection of ammonia can be done with the help of MQ series sensor which is very cost efficient and robust. The normal ammonia level in exhaled breath of healthy persons is **0.5 PPM**. The patients who are affected from cirrhosis will have ammonia concentration of **0.745 PPM**. The detected concentration is displayed in the display so that they know their state of health.

Through this method, we can ensure a person's safety by continuously monitoring the concentration of ammonia in exhaled breath at a particular time interval. It is one of the cost-efficient ways to detect the disease such that the poor people can afford it easily. One of the main advantages of this method that it does not involve risk factors like finger pricking and pain stacking methods involved in laboratory methods

II.LITERATURE SURVEY

Shimamoto C, Hirata I and Katsu K (2000) et. al, proposed **"Breath and blood ammonia in liver cirrhosis"**. Hyperammonemia would cause multiple organ dysfunction in persons with cirrhosis and hepatic encephalopathy. Hence, they monitored the concentrations of ammonia in blood with respect to the progression of disease and treatment efficacy. They studied the ammonia metabolism dynamics of cirrhosis in relationship between ammonia in breath and blood. The levels of ammonia in breath and blood were measured continuously in 10 healthy volunteers and 20 cirrhotic patients using ammonia electrodes. The results showed that ammonia level in blood and breath were positively correlated in cirrhotic patients. It is observed that ammonia levels in cirrhotic patients' breath were higher in cirrhotic patients (0.745 ppm) than in controls (0.278 ppm).

Yusoff I.M.M, Razaz Yahya and Omar W.R.W (2015) et, al. proposed **"Non-Invasive Cholesterol Meter using Near Infrared Sensor"**. They studied a simple non-invasive method for measuring cholesterol level in humans using Near Infrared (NIR) light with the range of wavelength 700nm-1400nm. The blood was illuminated at a number of wavelengths which were selected from NIR spectrum based on the information acquired from the simple test of skin components. The intensity of transmitted or reflected light were measured and compared between non-invasive meter and invasive meter.

Ji-Eun Chang, Dae-SikLee and Sang-Woo Ban (2018) et, al. proposed an **"Analysis of Volatile Organic Compounds in Exhaled Breath for Lung Cancer Diagnosis using a Sensor System"**. They have designed and fabricated a sensor system as a tool to diagnose the lung cancer. The breath of 37 patients were collected who have non-small cell lung cancer and 48 healthy controls in order to detect the lung cancer. The result obtained from the system uses a Multi- Layer Perceptron (MLP) data analysis and showed a total accuracy of 75%.

Michael Philips, Renee N. Cataneo and Peter Fisher (2006) et., al analyzed **Prediction of Breast Cancer using Volatile Biomarkers in the Breath"**. They evaluated VOCs assaying 51 asymptomatic women with biopsy- proven breast cancer and healthy 42 aged women. They used a fuzzy logic model for predicting breast cancer and found that this was superior to previous report findings. They did a random assignment with 64 training set data or 29 prediction set data and constructed a model which predicts breast cancer with sensitivity of 93.8% and specificity of 84.6%. They proved that breath test could provide a painless, safe and accurate screening test for breast cancer.

Ima O. Essiet (2013) proposed **"Diagnosis of kidney failure by analysisof the concentration of ammonia in exhaled human breath"**. In this study, they found that the extreme high concentration of ammonia in breath indicated kidney failure. As a result of kidney failure, the kidney would lose the ability to process the liquid waste in body. This would lead to increased Blood Urea Nitrogen (BUN) level in the body. Hence, they suggested an affordable breath analyzer for diagnosing kidney failure which had success rate of 85%. They thought that it would help patients seeking medical help immediately especially who lives in rural areas.

III.PROBLEM STATEMENTS

- Liver cirrhosis is one of the deadliest diseases in the world and it causes over 25000 deaths in US every year
- It eventually stops the liver from working properly and it leads to the final stage of cirrhosis which is a life threatening
- It causes other complications such as bleeding, swelling of legs and abdomen, jaundice and even worse like hepatic encephalopathy
- It is essential to diagnose earlier as soon as possible to prevent a human from death
- The diagnosing of liver cirrhosis is usually done using costly methods like Computed Tomography (CT), abdominal ultrasound, Magnetic Resonance Imaging (MRI), Magnetic Resonance Cholangiopancreatography (MRCP)etc.,
- The diagnosing procedure involves costly and invasive laboratory procedures which involves fingerpricking and pain staking methods

IV.OBJECTIVES

- The main objective of this project is to diagnose the liver cirrhosis in non -invasive way
- To prove that it is possible to diagnose the di se ase using Human Breath Analysis Technique
- To overcome the disadvantages, present in the traditional laboratorymethods
- To design a low-cost diagnostic method so that it can be available and affordable to all the poor people

V.PROPOSED METHODOLOGY

In this chapter we are going to discuss about the proposed methodology of our project. In this project we proposed Human Breath Analysis technique to identify the liver cirrhosis in a human. It is a technique in which various diseases in humans can be identified easily through exhaled human breath. In this technique, exhaled human breath is analyzed for the normal concentration of ammonia in order to identify the liver cirrhosis. One of the biggest advantages of this technique is the early detection of diseases in human beings in a non- invasive way. It is also time-consuming methodology to identify the liver cirrhosis comparing to invasive methodologies.

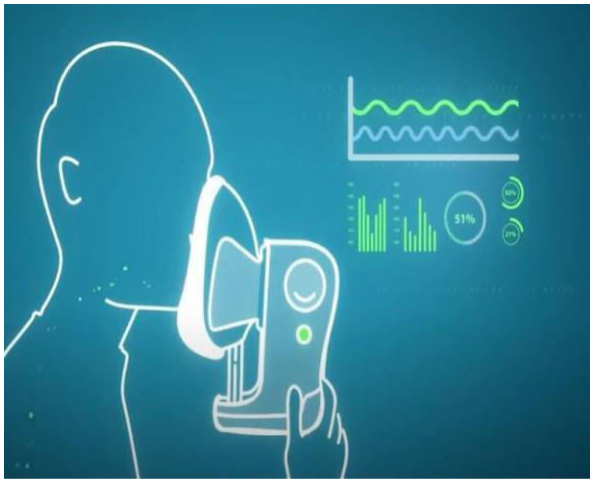

FIG 1 PROPOSED METHODOLGY

It is done with the help of gas sensing technology. For sensing the ammonia gas presented in our human breath as one of the 3500 VOCs, we have used a type of ammonia gas sensor called MQ 135 sensor.

It is a general-purpose sensor that it can be used for various purposes. The sensor is powered with the microcontroller which has a power source pin of 3.3V. The microcontroller used here is Node MCU which is the brain of this entire system.

VI.HARDWARE COMPONENTS NODEMCU

NodeMCU (Node Microcontroller Unit) is a general-purpose microcontroller unit. ESP8266 is a low-cost System on Chip (SoC) device that enables the working of advanced microcontroller unit and open - source equipment called Node MCU. It has Ten silica's L106 Diamond series 32-bit RISC architecture which serves as an open-source hardware development kit. It has an operating frequency range of 2.4 GHz to 2.5 GHz (2400 MHz to 2483 MHz). The operating voltage ranges from 2.5v to 3.6v with operating current of 80mA. Operating temperature of 40 to 125 degree centigrade. It consists of flash memory of about 4 MB and 128 KB RAM, so that we have a large memory size compared to other development boards. It has internal cache memory to improve the performance of the module.

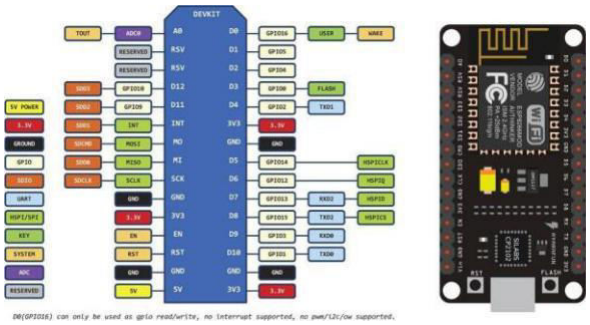

FIG 2 PIN CONFIGURATION OF NODEMCU

Express is the manufacturer of this compact ESP8266 SoC. Every essential equipments of the today's computers like Central Processing Unit, Read Only Memory and Random-Access Memory are all present along with Wi-Fi. They also include Software Development Kit with advanced framework. NODE MCU is the basic underlying structure of the small sized and low cost IoT products. The development board contains GPIO (General Purpose Input Output) pins which can readily connect to a working board. It is powered and programmed by a micro-USB port with built in LED lights, hardware reset button, and Wi-Fi Antenna.

MQ 135 SENSOR

MQ-135 sensor is an air quality sensor which is used to sense various gases like ammonia, carbon dioxide, alcohol, benzene, nitrous oxide and smoke. This sensor plays a significant role in almost every sector by detecting and monitoring various kind of gases. These MQ type of sensors are specially designed for this specific purposes.

FIG 2 MQ 135 SENSOR

The sensor has four pin configurations. They are as follows:

- Vcc - Power source for the sensor
- Ground - Ground connecting pin for the project
- Digital Output Pin - Digital data can be retrieved from this pin
- Analog Output Pin - analog raw value can be retrieved from this pin.

LIQUID CRYSTAL DISPLAY (LCD)

Liquid crystal Display (LCD) is a display panel, which uses liquid crystal technology for display process. It is a passive device such that it modifies the light which passes through it instead of creating the light. The intensity of the light in these LCD's can be changed through a potentiometer connected externally.

It is a 16×2 LCD display which means it is able to display 16 columns (16 characters) and 2 rows (2 lines), at one time we are able to display 32 characters. The communication between LCD and microcontroller is achieved through an I2C (Inter-Integrated Circuit,) serial communication protocol.

FIG 3 LCD

VII.SOFTWARE COMPONENTS

ARDUINO IDE

Arduino Integrated Development Environment is the full form of ArduinoIDE. Arduino Integrated Development Environment (IDE) is a software where the programming part for a particular hardware component is developed and it is a free source. The IDE can easily be supported by any operating systems like Mac, Windows, Linux etc. It can be used in both Windows and Linux since it is a

cross-platform application. Programs for microcontrollers like Arduino and NodeMCU can be written and booted with the help of Arduino IDE. The IDE's source code is openly available for public. The programming languages like C and C++ are supported in this IDE with some specific set of structuring in code.

FIG 4 ARDUINO IDE

BLYNK APPLICATION

Devices like NodeMCU, Raspberry Pi, and Arduino can be controlled by an Android and iOS application platform known as Blynk. Over internet Blynk can control few sheets. The fundamental idea behind the creation of blynk was Internet of Things. It is capable of performing several functions like displaying and store several real-world information like sensor data, pictures, and control devices remotely. The blynk can be set by selecting suitable widgets and generating auth token to connect through Wi-Fi. It can be monitored using blynk application.

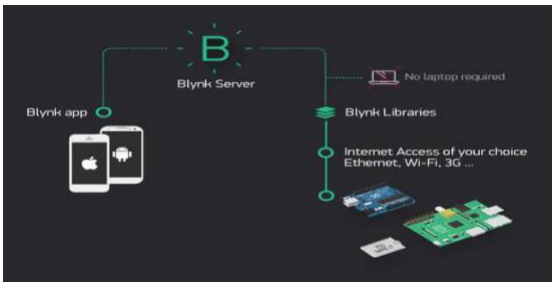

FIG 5 BLYNK APP FUNCTIONING

VIII. WORKING OF PROPOSED METHOD

In this chapter, we are going to discuss about the block diagram of this project. It provides a detailed information about this project in a very simple andeffective manner

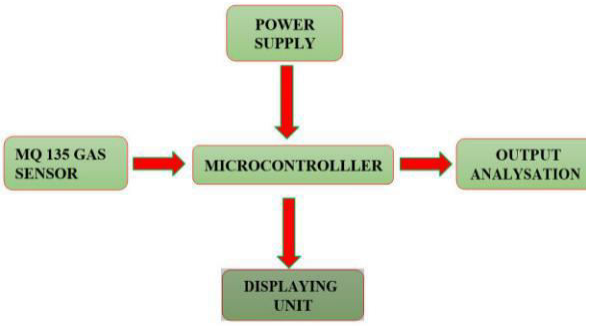

FIG 6 BLOCK DIAGRAM

The block diagram explains the simple working of the project. MQ 135 gas sensor is the sensing component which is used in our project to sense the concentration of ammonia in exhaled human breath. The sensor is connected to the microcontroller which is the brain of our project. The power supply of 3.3 V for the sensor is given through the microcontroller. The power supply for the microcontroller is given from the laptop or PC through micro-USB cable. The output obtained from the sensor is analyzed and compares with the standard value and the desired result is displayed in the displaying unit which is connected to the microcontroller.

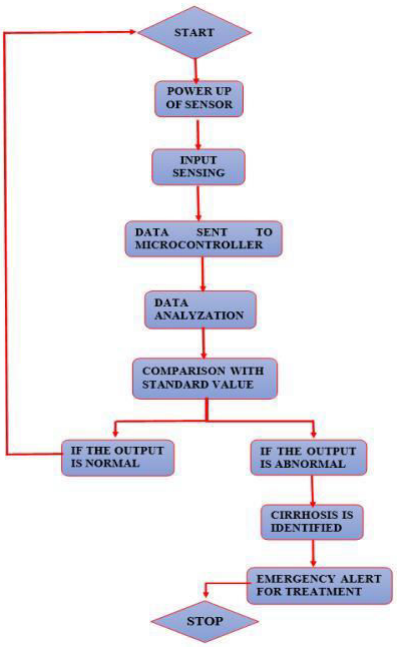

FIG 7 WORK FLOW

IX. RESULTS AND OUTPUT

The concentration of ammonia in human breath is detected using MQ 135 gas sensor. The data obtained from the sensor is compared with the normal standard value of the concentration of ammonia. If it exceeds the standard value, the person is identified with the liver cirrhosis. If the person is confirmed, it would alert the person through LCD display and also It would alert the person's relative through notification alert in blynk. The output is shown below:

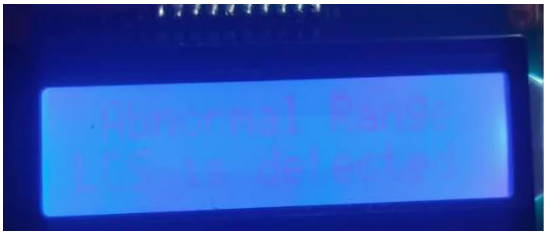

FIG 8 LCD OUTPUT

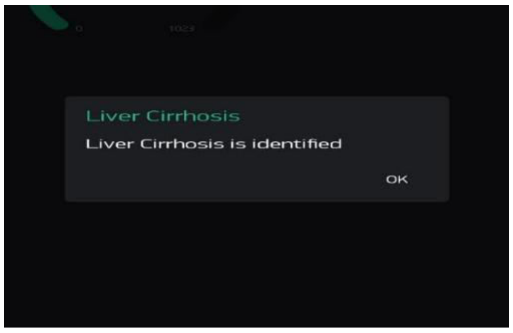

FIG 9 BLYNK NOTIFICATION OUTPUT

X.REFERENCE

[1] Akesh Govada, Ch Renumadhavi, K B Ramesh, "Non-Invasive Blood Glucose Measurement", International Journal of Advanced Research in Computer and Communication Engineering- 2014.

[2] Anuj Srivastava, Md Koushik Chowdhury "Blood Glucose Monitoring Using Non-Invasive Optical Method: Design Limitations and Challenges" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering -2013.

[3] Ashok V, Nirmalkumar A, "A Novel Method for Blood Glucose Measurement by Non-invasive Technique Using Laser" International Journal of Medical – 2011.

[4] Gilwon Yoon, Kye Jin Jeon, "Reagentless / Non-invasive Diagnosis of Blood Substances" IEEE Conference on Biomedical Engineering and Sciences, IEEE, 2013, pp.226