NON POKING METHOD FOR DETECTION OF CHRONIC KIDNEY DISEASE PATIENTS

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Abstract - *Kidney failure is one of the diseases recognized in the human based on the presence of the high content of ammonia (NH3) in human breath. The human mouth comprises various substances both in the form of liquid and gas. The health condition of an individual relies on the concentrations of each of these substances in the body. Ammonia is one of such substances whose concentration in the mouth reveals the presence or absence of diseases in the human body. The presence of ammonia in the exhalation of human is used to diagnose the impairment of Kidney. This disease is as a result of the kidneys' inability to process the body's liquid waste thereby resulting in high blood urea nitrogen (BUN) level. As the filtration rate of nephrons in the kidney reduces it results in the release of urea throughout the body which is dissipated in the form of ammonia through the oral breath. This paper proposes an affordable ammonia breath analyzer for the diagnosis of kidney failure in humans. The purpose of this research is to provide an affordable and reliable means of detecting kidney failure in hospitals and even in homes. This will help patients with the disease seek medical help quickly (especially those in rural areas). In the proposed project an ammonia gas Sensor (MQ137) was used to measure and analyze breath ammonia among a group of people including healthy human and various stages CKD patients. The proposed method provides an affordable, reliable and simple device which ease the detection of renal failure in the human.*

Key Words: Breath Analyzer, CKD detection, Ammonia levels, Non-Invasive, Renal failure, MQ137 gas sensor.

1.INTRODUCTION

The Increase in the Chronic diseases in the developing countries is the constitutes the major part in the increase in morbidity and mortality rate. In India the rapid increase of Kidney disease is not assessed exactly as there was a sudden increase in the Chronic Kidney Disease(CKD) throughout the country. The approximate prevalence of CKD is 800 per million population (PMP), and the incidence of end-stage renal disease (ESRD) is 150–200 PMP [1]. In a healthy individual, ammonia is converted to urea in the liver through urea and citric acid cycle. Urea is then transported through the bloodstream and excreted into the urine by the kidneys. In patients with CKD, an equilibrium concentration of ammonia and urea becomes imbalanced, resulting in higher levels of nitrogen containing metabolic waste products in the body. The concentration of Nitrogen increases when the Urea in CKD patients get degraded and the impact is realized as increase in ammonia percentage in saliva. Salivary ammonia evaporates into gas phase and is then excreted by breathing [2]. Breath dissection is a non-invasive method for precocious diagnosis or valuation of turmoil and disease conditions. The major merit is that, it produces instant results without waiting for laboratory analysis, the test is limitlessly repeatable, and moreover it is less invasive to patients than blood analysis [3]. To estimate the percentage of Ammonia in the exhalation of a human being an electrochemical sensor was used among the group of people and patients with CKD [2]. The kidney impairment can be diagnosed with the observed level of ammonia in the breath and even the treatment can also be monitored [8].

2. PROPOSED METHOD

This method is based on the Breath analysis. In CKD patients the level of ammonia is high due to the improper functioning of kidney. By designing a breath analyzer circuit using the ammonia gas sensor the level of ammonia in oral breath are identified. Breath Samples are collected from the normal person and CKD patients through a tube. The collected samples are sent to ammonia gas sensor (MQ137) which is highly sensitive to ammonia. The sensor senses the ammonia gas in breath sample and send the amount of concentration of ammonia gas to the Arduino UNO. The sensor module has both analog and digital output.

The analog output measured for achieving the good accuracy of the PPM value. By setting the threshold limit of ammonia gas using the Arduino UNO the normal person and the CKD patients are discriminated. Using LCD the ammonia level in terms of PPM displayed. The level of ammonia in normal person is below 1.2 ppm and for CKD patient the ammonia level ranges from 1.2 to 6.5 ppm based on the severity of the disease [2]. Hence kidney Impairment level can be diagnosed non-invasively.

3. OBJECTIVE

To design a low cost device to measure the level of ammonia in human breath to detect the chronic kidney disease patients

and the severity of the disease. Chronic kidney disease patients are identified instantly without any delay as in laboratory tests. To design a non-invasive diagnosis method to detect the chronic kidney disease patient.
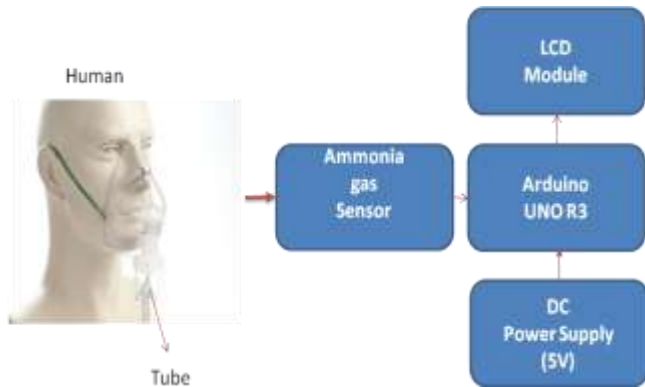
4. BLOCK DIAGRAM

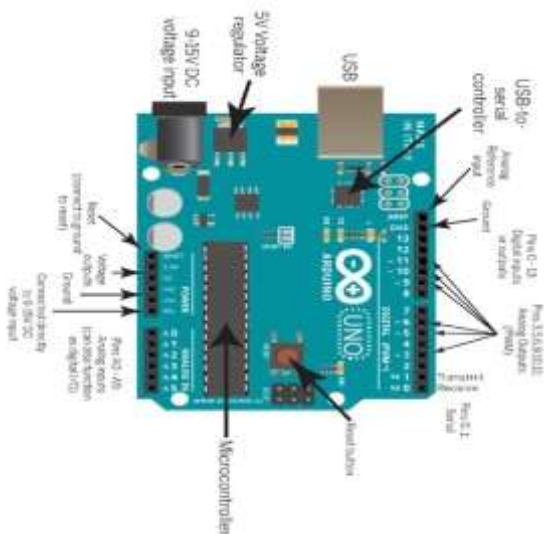*Fig 1-Block diagram of proposed system*

4.1 ARDUINO UNO

Fig 2-Arduino Board

Arduino is a single-board microcontroller which makes the application more accessible between the interactive objects and its surroundings. The Current model consists of a USB interface, 6 analog input pins and 14 digital I/O pins that allow the user to attach various extension boards. The USB-to-serial converter feature in ATmega328P microcontroller and an ATmega16U2 (Atmega8U2 up to version R2) differentiates from all other Uno boards available earlier. It has 14 digital input/output pins in which 6 can be used as PWM outputs, an ICSP header, 16MHz ceramic resonator a USB connection, 6 analog inputs, a power jack and a reset button. This board contains all the required support needed for microcontroller. They are simply connected to a computer with a USB cable or

with an AC -to-DC adapter or battery in order to get started. The physical quantity measure by the sensors is sent to the microcontroller which was programmed to manipulate the sensed the data as per the requirement of the application and implement the control in turn to the field. By responding to sensors and inputs, the Arduino is able to interact with a large array of outputs such as LED and displays. Because of it's flexibility and low cost, Arduino has become a very popular microcontroller..

4.2 AMMONIA GAS SENSOR

Fig 3- Ammonia gas Sensor (MQ137)

The most widely using gas detecting sensor is MQ series gas sensor. In order to detect the ammonia gas in the human breath the MQ137 which is highly sensitive to ammonia is used. In MQ137 ammonia gas sensor, the gas sensing material is SnO_2(Tin oxide) which act as a lower conductivity in clean air [9].These sensor are based on electrochemical principle and vary their resistance when exposed to ammonia gas, internally it has a heater increases the internal temperature and the sensor react with gases causing a change in the value of resistance.

The heater depends on the voltage, the sensor behaves like a resistor and needs a load resistor to close the circuit and be able to read it from a microcontroller due to the heater it is necessary to wait for a warm up time for the output to be stable. The MQ137 sensor module has 4 pins VCC, ground, analog output, digital output.

The MQ137 sensor modules, which simplifies the connection part and facilities its use, it is enough to feed the module and start reading the sensor, these modules have a digital output which internally work with a comparator. The digital output shows the presence or absence of gas. For the accuracy of PPM level we are measuring the analog output.

4.3 LIQUID CRYSTAL DISPLAY

*Fig 4- LCD 16*02*

The LCD 16*02 display module contains 16 pin, used to display the PPM levels of ammonia gas from the breath sample. The term LCD is an acronym of liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations. The R/W pin Toggles the LCD between Read/Write Operation. The Pin 7-14 are data bits (DB0-DB7) pins used to send command or data to LCD. The pin 6 enable control pin must be held high to perform read/write operation. Pin 15 and 16 are the LED positive and negative Pin.

4.4 ARDUINO IDE

Arduino is a micro-controller board based on ATmega328 that needs to be programmed and it is fed with a hex code version of the code written in high level language. The Arduino Integrated Development Environment (IDE) is a cross-platform application that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards So, Arduino development boards are fed with the code via Arduino IDE. Embedded C language is used as a language to code on Arduino IDE. The Arduino IDE provides the necessary software library derived from the Wiring project based on which input and output procedures are framed in common. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program sub-main into an executable cyclic executive program which includes the GNU toolchain and also the IDE distribution. The conversion of the executable code into a text file which in turn as hexadecimal encoding is achieved by the he Arduino IDE program. Finally the converted hexadecimal code is loaded into the Arduino board by a loader program in the board's firmware.

5. INTERNAL CIRCUIT DIAGRAM

Arduino UNO has 14 digital pins and 6 analog pins. The MQ137 sensor module has 4pins. VCC, Ground, Analog output, Digital Output. An analog input pin of the Arduino reads the analog output of the sensor. An Arduino is programmed to read the value from sensor and display the value in Liquid

crystal display (LCD). The Arduino and LCD are interfaced with the I2C module to Display the ammonia levels.
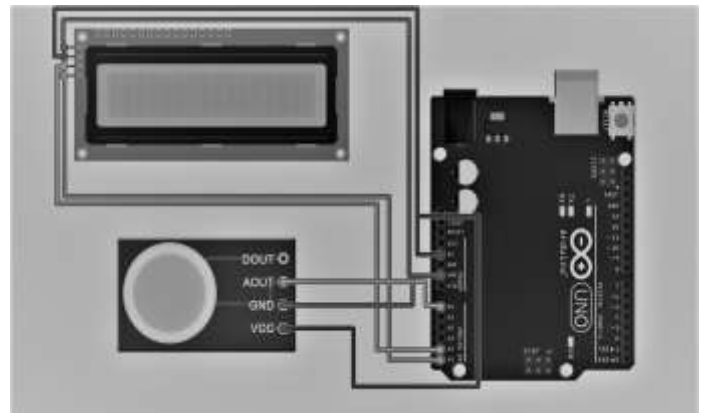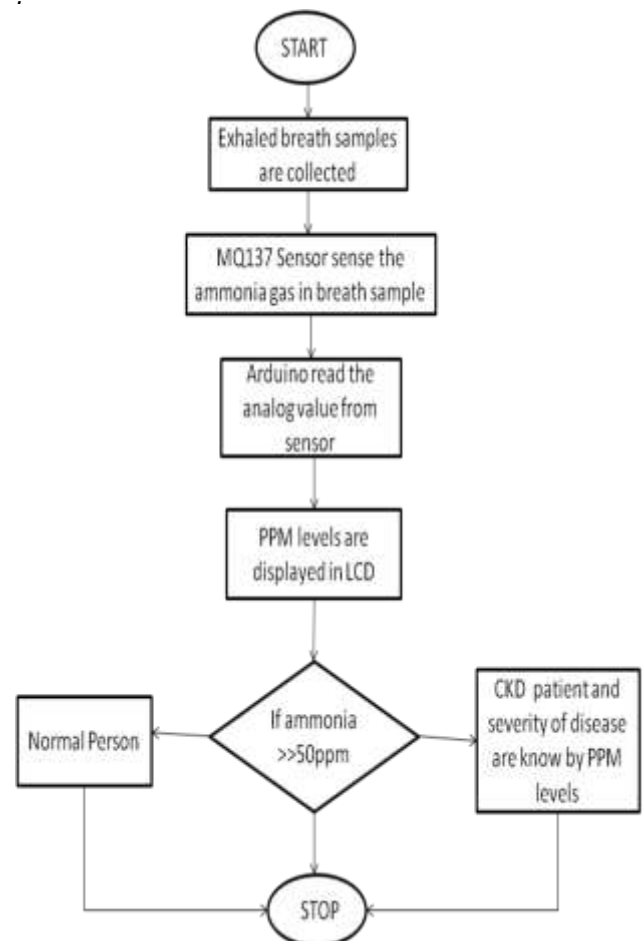

Fig 5- Circuit Diagram

6. DESIGN FLOW

Fig 6- Flow chart

Exhaled Breath samples are collected from the normal person and CKD patients through a tube. The breath samples are sent to the ammonia sensor, it senses the ammonia gas and gives

the analog output in terms of the voltage in proportion to the concentration of the gas. The microcontroller reads the analog value and ppm levels are displayed in the LCD. The digital output from sensor module indicates the presence or absence of ammonia gas. The analog output is preferred for measuring the ammonia level in ppm for the sake of accuracy . The normal person and CKD patient are discriminated by setting the threshold levels in Arduino UNO. For normal person the ammonia level is below 1.2 ppm and for CKD patient the ammonia level is above 1.2 – 6.5 ppm.

7. IMPLEMENTATION OF PROPOSED SYSTEM

Fig 7 – Implementation diagram

8. CONCLUSION

Ammonia concentrations of Normal persons and CKD patients were observed. The candidates without CKD has lower breath ammonia concentrations and candidates with CKD has higher breath ammonia concentrations. It results that breath ammonia analysis is an effective and accurate method of diagnosing kidney failure. Breath ammonia analysis may be used by medical practitioners for the diagnosis of kidney failure and it can also be used for treatment accuracy of CKD patients.

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BIOGRAPHIES

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