

**NATIONAL INSTITUTE OF BUSINESS MANAGEMENT
HIGHER NATIONAL DIPLOMA IN SOFTWARE ENGINEERING
COURSEWORK**

Internet of Things

IoT based Health Monitoring System for Asthmatic Patients

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Abstract

With the technological advancement in the modernized world most of the manual processes has been Subject to the automate in order to increase the efficiency, accuracy and the performance. Among those, health care and medicine sector also move to automate in order to provide a better service for the patients. Then considering the asthmatic patient, they need constant care and supervision of the caretaker or doctor. Most of the time the caretaker needs to be continuously monitoring the patient as their specific conditions need prior medical attention. To overcome this by an automated system, we have proposed an IoT based wrist band which will monitor the patient's heart rate, environment air quality, SPO2 levels and also a GPS tracker to track the patient's location. To ensure the patient's privacy, the mobile has a login for the patient to manage (activate and deactivate) the GPS feature as well. The system will be connected to a mobile app which has an interface for the caretaker and the patient for giving alerts. The mobile application also contains a dashboard to manage the functions of the wristband as well. Additionally, its mobile application will provide you with the current information collected by the device. By implementing this system, the asthmatic patient's safety can be increased which reduces the manpower.

Acknowledgement

We would like to express my gratitude to my make sure Mr. Bhathiya Seneviratne who guided me to implement this IoT-based Health Monitoring System for Asthmatic Patients by giving the needed instructions and support. Also, I would like to express my thanks to all the open-source platforms which gave us knowledge about IoT concepts and implementation guidance. We would appreciate the online tools which facilitated the project by providing the essential libraries, and tools to enhance our academic and practical experience. And we hereby make this an opportunity to thank our parents and peers for their support given to complete this project as well. The collaboration and teamwork between our team members was the backbone of the successful completion of the project. Finally, we heartfully thank our educational institute NIBM School of Computing, which gave us the opportunity to spend our valuable academic experience in IoT concepts by providing laboratory experience.

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1. Literature Review

When it comes to asthmatic patients' condition, constant monitoring and medication should be provided in order to save their lives and for diagnosing the disease. Many researchers and scientists have suggested number of methodologies and emphasized their focus in relevant field. As Gibson (200) says, to diagnose the smaller the patient needs to monitor symptoms for the disease regularly. He suggests regular checkups, action plans and monitoring the symptoms in a periodic way. According to his research, he focuses on self-monitoring beyond a caretaker. When considering the research report by Mohammed et al (2024), it mentions about the problems faced by asthmatic patient India satisfaction levels. The research was based on a statistical analysis using a survey distributed among the patients. According to the research, it also implies that an automated device for asthmatic patients is an upcoming requirement. But niranjana et al. (2020), focused on solving this problem using IoT based solution assist smart management system. Air quality checker and heart pulse rate identifier were Included in the proposed system. But when considering these research reports, there is a clear gap in field of asthmatic patient study he's identified. Therefore, our system focuses on an automated solution as a variable device for asthmatic patients as mentioned below.

2. Introduction

2.1 Problem Statement

When considering the healthcare sector, asthma is a vital disease which requires constant supervision of a caretaker in order to ensure their safety. However, constant monitoring is an inaccurate task which can be done by human power. Moreover, the article cannot manually check the yeah quality around the patient, oxygen level, heartbeat level and the SPO2. Even when the monitoring is somewhat efficient the patient is awakened, when considering a situation where the patient gets symptoms of asthma when the individual is sleeping, the possibility to respond to the patient is very less. As a result, increase of death rate due to asthma has been increased by emphasizing the need of focusing on the called problem.

2.2 Solution

As the solution for this problem, we have proposed a “IoT based Health Monitoring System for Asthmatic Patients” which include the following features to overcome above-mentioned problems while increasing the user engagement.

The system has been planned to implement a wearable device with the following features to ensure the patients’ safety.

- The device tracks heart rate and oxygen levels
- Monitors air concentration to check whether surrounding is harmful or not
- GPS to get the patient location
- Emergency button to press when a patient needs help
- Cough tracking feature to ensure that the caretaker can hear the patient

The device will grab all the data and send notification to the care takers phone. A dashboard will support the caretaker and the patient to manage the device.

Provided approach will automate the function manually performed and provide details of accurate condition of the patient as well.

2.3 Objective

The objective of this product is to minimize the death rate due to improper attention given to asthma patients by an IoT-based solution. By deploying the system, we expect the following.

- Transmitting real time data in between patient and caretaker.
- Providing a user-friendly and compatible mode of solution
- Quick responses for the patients when they face difficulties internally or externally.

3. System Design and Architecture

3.1 Hardware Components

The proposed system requires following main components in order to fulfil the required functionalities.

- MAX30100 Pulse Oximeter SpO2 and Heart Rate Sensor Module – to measure the heart rate
- NodeMCU ESP8266 WiFi ESP-12E CH340 IoT Dev Board Module – to collect data from sensors and send to firebase
- MQ-135 Air Quality Sensor Hazardous Gas Detection Sensor – check whether there are any harmful gases
- LM386 Electret Microphone Audio Amplifier Sound Sensor 3 pin Module, vibration sensor and heart rate sensor – collectively tracks when patient coughing
- NEO6MV2 New NEO-6M GPS Module – track patients' location
- Right Angle tactile push button – as the emergency button

Other than these required components will be mentioned in the bill of materials.

3.2 Software Components

The Following software are needed in order to run the IoT based health tracking wristband.

- Arduino IDE – To upload the code to NodeMCU ESP8266
- GitHub – Version Control purpose

Other than the above-mentioned software requirements the following are needed to implement the mobile application which is used to manage the system. The mobile application will be managed by the caretaker and patient in order to manage and

manipulate collected data and used to view the real-time location of student as well. The application is also used to activate and deactivate relevant features in order to save power and to enhance the user friendliness other than the motion sensor. The following is the tech stack used.

- Tool – Android Studio
- Programing Language – Java
- Real time database – Firebase SDK
- Location – Google map API
- Layout designing - XML

The integration of the above-mentioned tech stack will enhance the efficiency of “IoT based Health Monitoring System for Asthmatic Patients”.

3.3 Bill of Materials

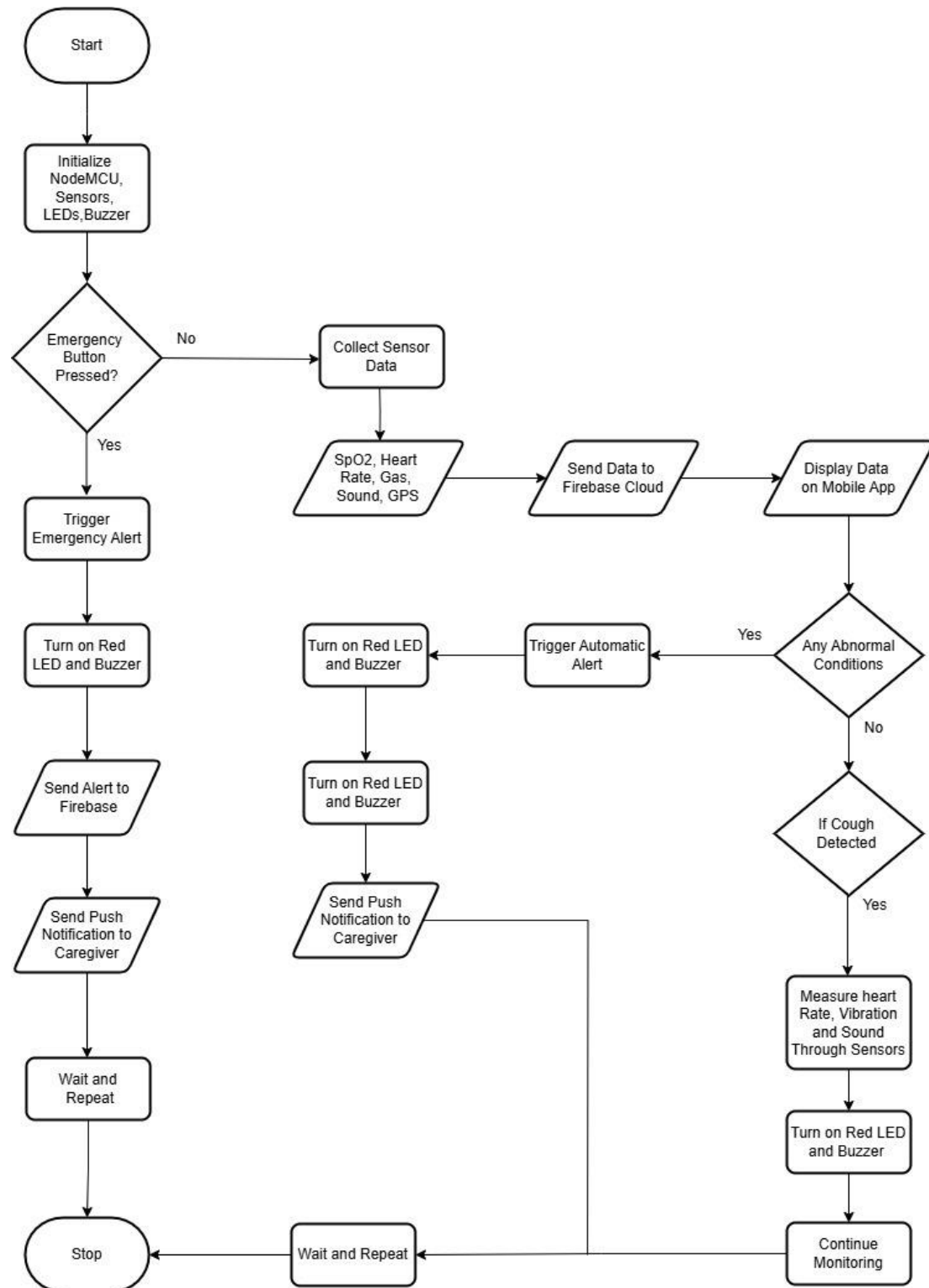
Component	Quantity	Amount (Rs)	Total (Rs)
NodeMCU ESP8266 WiFi ESP-12E CH340 IoT Dev Board Module	1	800	800
MAX30100 Pulse Oximeter SpO2 and Heart Rate Sensor Module	1	420	420
MQ-135 Air Quality Sensor Hazardous Gas Detection Sensor	1	490	490
LM386 Electret Microphone Audio Amplifier Sound Sensor 3 pin Module	1	690	690
NEO6MV2 New NEO-6M GPS Module	1	1150	1150
801S Vibration Sensor detection module	1	680	680
Right Angle tactile push button	3	10	30
Breadboard	1	130	130
Jumper Wire Male to Male (10cm)	2 Pack	140	280
Jumper Wire Male to Male (10cm)	2 Pack	130	260
Jumper Wire Male to Male (20cm)	1 Pack	160	160
USB Cable (For ESP/TTL module)	1	380	380
WIFI Router	1	2500	2500
LED	2	50	100
Buzzer	1	200	200
3.7v 3200mA Li-ion Rechargeable battery	2	520	1040
Small Screws	10	5	50

Electrical Tape/black tape	1 Roll	200	200
Cable Ties	10	5	50
Capacitors	10	10	100
Nuts and Bolts	10 Sets	10	100
Plastic Mounting Board	1	330	330
Glue Sticks	6	40	240
Glue Gun	1	720	720
Soldering Iron	1	790	790
Soldering Wire	01 role	120	120
Soldering Iron Stand	1	490	490
Scissor	1	150	150
Glue (normal)	1	115	115
Bristol Board	1	55	55
Super Glue	1	95	95
Multimeter	1	700	700
Paper Cutter	1	200	200
Double Tape	1	750	750
Plier	1	1470	1470
Resistors	01 pack	50	50
Other			200

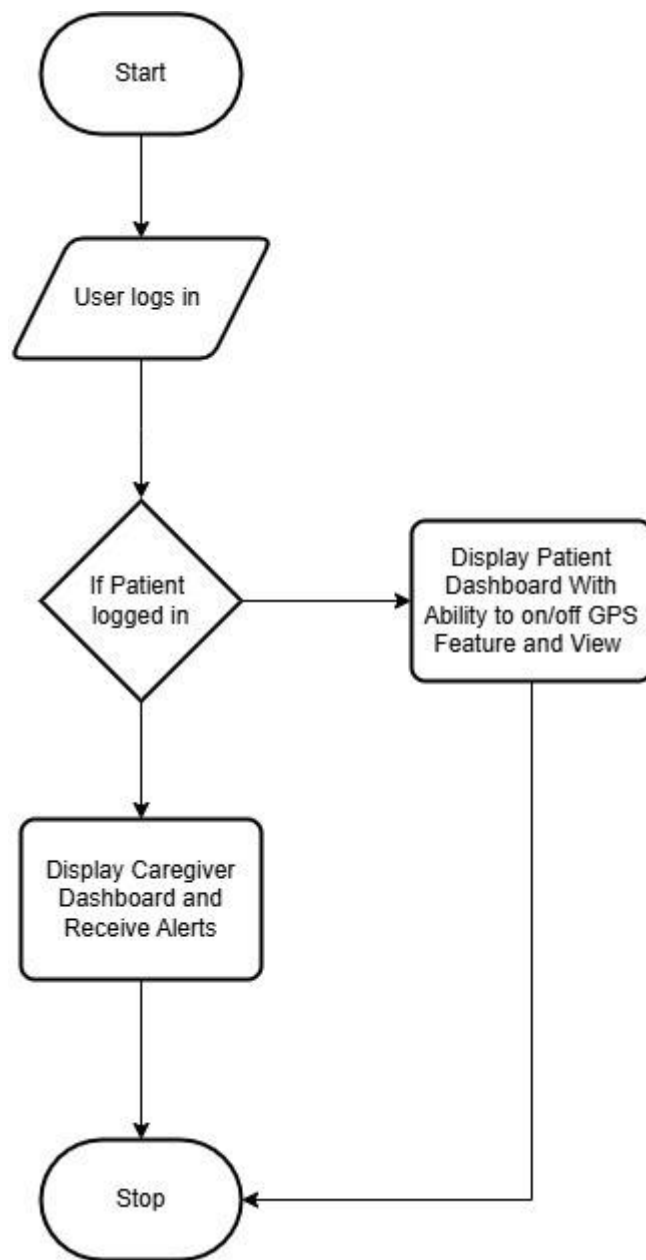
Total Amount			Rs. 16285.00
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4. Methodology

The completed methodology and the process flow is shown in the format of a flow chart as follows.



Following flow chart displays the workflow of mobile application.



5. Discussion

The proposed IOT based wearable device is supporting the caregiver using the above-mentioned oxygen levels, heart rates, environmental air concentration tracking functions along with GPS module to check the patient's location and with the push button to hit when the patient needs support. Also, the device detects the cough symptoms by integrating heart rate, sound and vibration for notifying the caregiver about patient's condition. The real time messages will be passed to caregiver's mobile app while displaying the real tracked data using the sensors. Moreover, there are many features which can be added to the device as well as which should be mitigated in order to enhance the functionality of the device.

5.1 Recommendation

- Usage of highly accurate sensors for better results
- Implementation of data storage options to be used when offline
- Confidential data of the user should be protected
- Combine AI in order to emphasize new functionalities such as predictions
- Implementing a display in device for the use of patients to track their own levels

5.2 Limitations

- Accuracy of sensors may affect the functionality of the device
- WIFI connectivity may affect the overall functionality
- Battery life is limited due to multiple sensor usage
- Delays in the firebase network may result in late alerts
- GPS module may find it hard to track indoor locations at certain times
- Database scalability will affect the effectiveness of device

6. TimeLine

Phases	Week 01	Week 02	Week 03	Week 04	Week 05	Week 06
Research and Feasibility Study						
Design and Planning						
Prototyping the Hardware						
Coding and Mobile app development						
Testing the functions						
Debugging the errors						

1. Research and Feasibility Study

Research about the relevant hardware components to implement the system.

2. Design and Planning

Gathering all those hardware components and making the connection in between them.

3. Prototyping the Hardware

Creating an outer cover with relevant hardware components to depict the shape of a wristband with additional hardware components and connections.

4. Coding and implementation of mobile application

Choosing a programming platform and program the system according to the functions needed and developing the mobile application and integrate with the firebase database which has the data retrieved from sensors.

5. Testing the functions

Run the system and identify its errors and areas to improve.

6. Debugging the errors

Debug and modify the system with relevant modifications.

7. References

Smart Monitoring System For Asthma Patients Article in International Journal of Electronics and Communication Engineering · May 2020 DOI: 10.14445/23488549/IJECE-V7I5P102

Patient experiences of their current asthma care and their views toward providing support for patients with asthma in community pharmacy: A Qualitative study Aseel Mahmoud a,* , Rachel Mullen b,c , Peter E. Penson b,c , Charles Morecroft b,c

Monitoring the patient with asthma: An evidence-based approach Peter G. Gibson, MBBS, FRACP Newcastle, Australia

8. Appendices