DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

NORTH SOUTH UNIVERSITY

CSE498R

DIRECTED RESEARCH REPORT

IoT (Internet of Things) Based Health Monitoring System For Elderly People

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Section: 01

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LETTER OF TRANSMITTAL

15 December, 2022

Dr Rajesh Pallit

Chairman,

Department of Electrical and Computing Engineering

North South University, Dhaka

Subject: **Submission of Directed Research Report on "IoT Based Health Monitoring System for Elderly People".**

Dear Sir,

With due respect, we would like to submit our Directed Research Report on "IoT Based Health Monitoring System for Elderly People" as a part of our BSc program. The report deals with a review on existing IoT based system for monitoring Elderly people and suggest improvements. We tried to the maximum competence to meet all the aspects required for this report.

We will be highly obliged if you kindly receive this report and provide your valuable judgement.It would be our immense pleasure if you find this report useful and informative to have an apparent perspective on the issue.

Sincerely Yours,

…….

Ishrat Jahan

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…….

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[IoT Based Health Monitoring System for Elderly People]

By

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Declaration

We the member of the group hereby declare that the project work entitled “IoT based Health Monitoring System for Elderly People” has been prepared by us during the semester FALL 2022 under the guidance of Dr.Dihan Md Nuruddin Hasan ,ECE Department, North South University in the partial fulfillment of CSE498R (Directed Research) prescribed by the university.

We additionally proclaim that this project is the result of our own effort, that it has not been submitted or copied from some other source or submitted to some other University or Institute for the honor of any degree or confirmation.

Student Names & Signature

Ishrat Jahan

Nowsin Tasnim Ahamed

Acknowledgement

We have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals and organizations. We would like to extend our sincere thanks to all of them. We are highly indebted to Dr.Dihan Md Nuruddin Hasan sir for his guidance and constant supervision as well as for providing necessary information regarding the directed research. Last but not least, many thanks go to the team who has invested full effort in achieving the goal.

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Internet of Things (IoT) based Health Monitoring system for Elderly People

***Abstract*--- It is true that nowadays people in industrialized nations can expect to live longer than before. As people live longer and the populations of developed countries grow older, several health related problems can be anticipated. With the expansion in the quantity of total population of old residents as well as the worldwide future and the development of innovation, the improvement of intelligent monitoring system in the healthcare has turned into a need. With age, the older loses a large portion of their mental capacities which can be perilous on the off chance that they are living alone. This research paper, overviews on the advances made in IoT based health care systems and methods and reviews those technologies in detail. Besides, this survey classifies each paper's existing systems and represents a summary of all works in brief. It additionally provides a complete review on IoT medical services applications and administrations. In this survey, we break down security, security highlights comprising of information assurance, network engineering, nature of administrations, applications improvement and nonstop observing of medical services that are confronting hardships in numerous IoT based medical services. The survey was conducted on journals that were relevant to the topic and each paper was carefully examined to identify gaps and future areas of research.**

I. INTRODUCTION

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction [1]

Before the existence of IoT, patient's connections with doctors were restricted to visits as it were. It was absolutely impossible that specialists or medical clinics could screen patient's wellbeing consistently and make suggestions in like manner. Internet of Things (IoT) empowered devices have made remote observing in the medical services area conceivable, releasing the possibility to keep patients protected and sound, and engaging doctors to convey care. It has likewise expanded patient commitment and fulfillment as communications with

specialists have become simpler and more effective. Moreover, remote checking of patient's wellbeing helps in diminishing the length of medical clinic stay and forestalls re-confirmations.

IoT likewise significantly affects lessening medical services costs fundamentally and further developing therapy results. IoT are without a doubt changing the medical services industry by rethinking the space of devices and individuals communication in conveying medical services arrangements. IoT has applications in medical sector that benefit patients, families, doctors, clinics and insurance agencies as well.

IoT for Patients - Devices in the form of wearables like fitness bands and other wirelessly connected devices like blood pressure and heart rate monitoring cuffs, glucometer etc. give patients access to personalized attention. These devices can be tuned to remind calorie count, exercise check, appointments, blood pressure variations and much more.

As this sort gadgets empower patients or elderly individuals to be observed by their doctors and approved staff from distance. The framework permits older patients to stay in contact with their relative who could continuously know about their state of being.

IoT for Physicians - By using wearable's and other home monitoring equipment embedded with IoT, physicians can keep track of patients' health more effectively. They can track patients' adherence to treatment plans or any need for immediate medical attention. IoT enables healthcare professionals to be more watchful and connect with the patients proactively. Data collected from IoT devices can help physicians identify the best treatment process for patients and reach the expected outcomes.

IoT for Hospitals - Apart from monitoring patients' health, there are many other areas where IoT devices are very useful in hospitals. IoT devices tagged with sensors are used for tracking real time location of medical equipment like wheelchairs, defibrillators, nebulizers, oxygen pumps and other monitoring equipment. Deployment of medical staff at different locations can also be analyzed real time.

IoT for Health Insurance Companies – There are numerous opportunities for health insurers with IoT-connected intelligent devices. Insurance companies can leverage data captured through health monitoring devices for their underwriting and claims operations. This data will enable them to detect fraud claims and identify prospects for underwriting. IoT devices bring transparency between insurers and customers in the underwriting, pricing, claims handling, and risk assessment processes. In the light of IoT-captured data-driven decisions in all operation processes, customers will have adequate visibility into underlying thought behind every decision made and process outcomes [2]

II. PROBLEM STATEMENT

The number of older residents coming to care homes has exacerbated the social disengagement and depression experienced by numerous old and vulnerable individuals, causing expansion of serious medical problems. Fortunately, innovation can help caretakers, medical service experts, and relatives in recognizing and cautioning old people's progressions in conduct, which can assist with preventing any health risk or issues they might face.

The introduction of IoT-based systems can possibly satisfy the prerequisites of old patients who need constant monitoring .Commonly, IoT based system includes monitoring of different health conditions or creating a platform to interact with the caretakers .Oximeters, wearable and health apps are some common examples most prominently used by the Elderly. Many tasks zeroed in on using various viewpoints to assemble the system to make it beneficial for the Elderly yet some way or another a few elements are missed out. This paper analyses the existing systems concerning IoT and Elderly and does a comparison with all the papers analyzed specifying the shortcomings in each paper and what new improvements can be added .This will help us understand what news features need to be introduced to make the systems more fruitful.

III. LITERATURE REVIEW

In [3] authors Yousuf Al Husaini, Mohammed Marhoun Alnuaimi, and Sherimon Pc published a conference paper in researchgate.net which shows the development of a project that emphasized the need for proper elder care and healthy aging. The project monitors Spo2 level, heart rate using **MAX30100** module and temperature level using **LM35** module. It likewise has a set typical worth that would caution the normal figures about any varieties. It also has fall detection sensors which detect movements and alerts which are sent through **GSM** Module and **IFTT** web application.

MAX30100 SENSOR: This sensor works at a voltage of 1.8V-5.5V and has two LED's, one emitting a red light and other infrared light. Infrared light is utilized for the beat rate and both these lights are utilized for estimating the oxygen levels in the bloods. The sensor peruses the retention levels for both light sources and stores them in a buffer which is perused by I2C. It is handled by doing test preliminaries. SpO2 and heartbeat values are finished utilizing the forefinger, brow.

LM35 SENSOR is a temperature sensor that gives temperature inside a scope of - 55C to 150 C. The temperature reading is in Celsius. This simple value is changed over utilizing NodeMCU ADC. Temperature Sensors works in a manner which changes over a temperature value into a voltage value.

MPU6050 SENSOR is a Micro Electro-Mechanical System (MEMS) is a Tracking Device which operates at a voltage of 3-5V. It comprises of a 3-axis Accelerometer, 3-axisGyroscope and Digital Motion Processor. It has I2C interface to communicate with the microcontrollers and comes with a Built-in 16-Bit ADC which will provide high accuracy.[4]

GSM MODULE (SIM 800A) SIM800 combines TCP/IP protocol and extended TCP/IP AT are used in this project for data transmission applications. SIM800A helps in transferring of voice, SMS and data with efficient power consumption.

IFTT is an application that associates gadgets to send/get a few web services utilizing conditional statements set off by changes that happen inside the microcontroller. IFTTT is a well-known responsive programming application where applets can convey north of 400 administrations of IoT items and web applications. In IFTT a help called web hook is given that deals with the ESP8266programmed in Arduino IDE. During arrangement, "this "trigger and "that" occasion (sending a SMS) was designed in the IFTT site itself. After arrangement, unique Programming interface key is given by the IFTT application which must be remembered for the modified code.

The LM35, MAX30100(heart rate), MAX30100(SpO2 level) in real time all had an accuracy above or equal to 90%.It also implemented the fall detection system for sending alerts about unexpected falls.

The following were the accuracy graphs obtained:

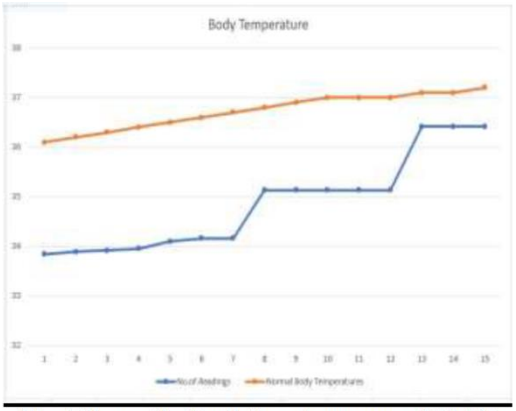


Fig 4 **Shows the Real-time Accuracy of LM35**

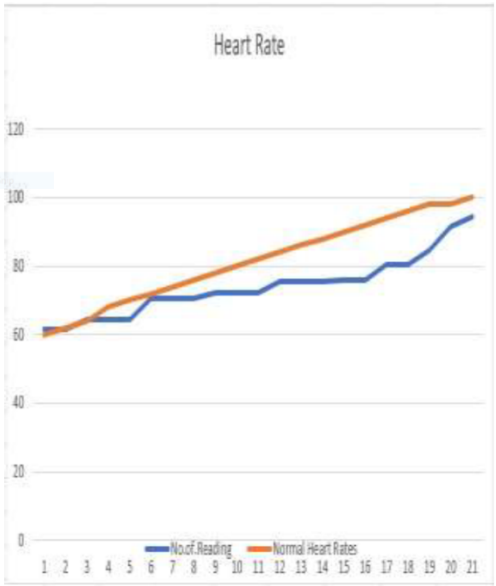


Fig 5 Plots the accuracy of MAX30100(heart rate)

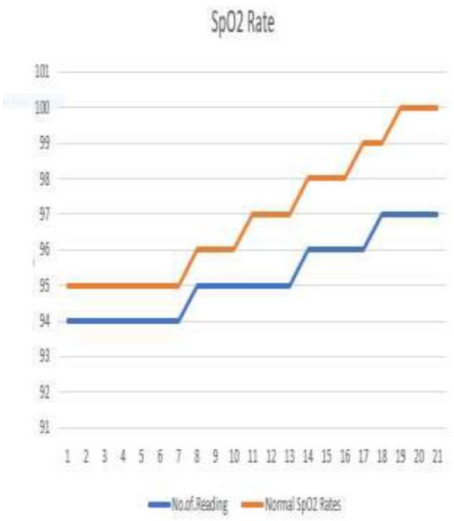
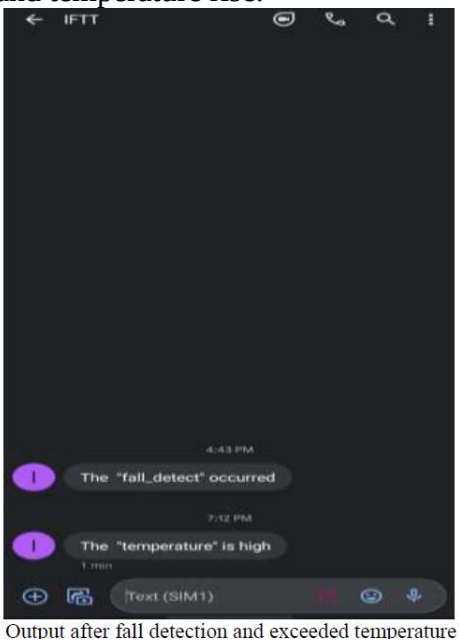


Fig 6 Plots the accuracy of MAX30100(SpO2 level)

In case of any deviation of heart rate, temperature or any fall detection from the normal value, a SMS is sent to the respective caretakers of the patient.

The following is the output received by the user through the IFTT app about the fall detection and temperature rise.



Output after fall detection and exceeded temperature value.

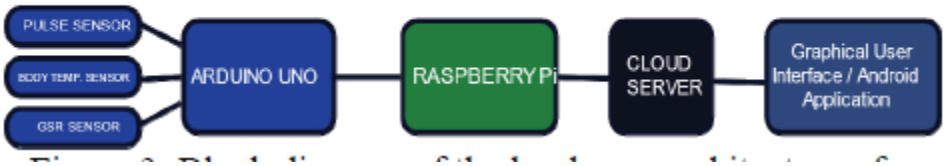
Overall the project had good accuracy with important sensors inbuilt.Besdies the addition of SMS alert would greatly help monitor the patients' health and keep in check the elderly's from time to time.

In [5] Mohd. Hamim, S. Paul, S. I. Hoque, Md. N. Rahman, and I.-A. Baqee published a conference paper in IEEE on IOT Based Remote Health Monitoring system for patients and Elderly people. This health monitoring application not only included elderly patients but also people of all age. It comprises of heart rate sensor, body temperature sensor, and galvanic skin response sensor. All of these sensors were integrated into one system with Arduino UNO and Raspberry Pi. Every result from the data is being sent to the cloud storage through raspberry Pi and the cloud storage is being updated in a real-time database. This data is accessed using an Android application which will output a graphical representation of the health results.

The author of the selected article used the technique of photoplethysmography for measuring the heart rate. Photoplethysmography (PPG) is an uncomplicated and inexpensive optical measurement method that is often used for heart rate monitoring purposes. PPG is a non-invasive technology that uses a light source and a photo detector at the surface of skin to measure the volumetric variations of blood circulation. Recently, there has been much interest from numerous researchers around the globe to extract further valuable information from the PPG signal in addition to heart rate estimation and pulse oxymetry readings. PPG signal's second derivative wave contains important health-related information. Thus, analysis of this waveform can help researchers and clinicians to evaluate various cardiovascular-related diseases such as atherosclerosis and arterial stiffness. Moreover, investigating the second derivative wave of PPG signal can also assist in early detection and diagnosis of various cardiovascular illnesses that may possibly appear later in life. For early recognition and analysis of such illnesses, continuous and real-time monitoring is an important approach that has been enabled by the latest technological advances in sensor technology and wireless communications. [6]

The hardware architecture of the project was pretty basic. It had Arduino Uno for sensing the health parameters and the Raspberry Pi which will gather the information in the cloud server. The aggregated date will be accessed by an Android application.

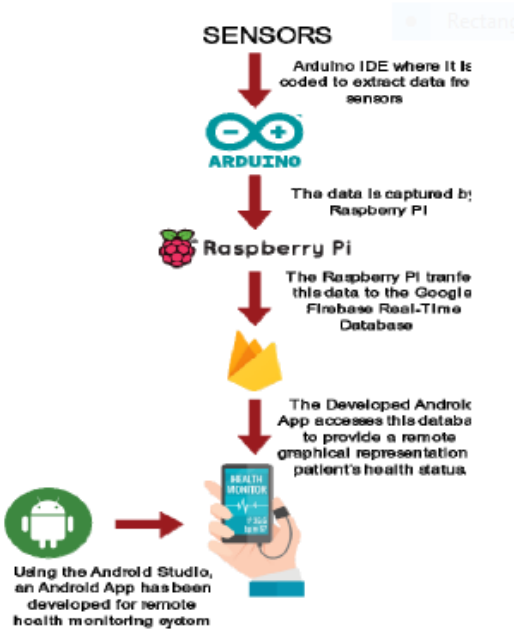
The following was the hardware architecture of the project



Each of the hardware components was calibrated beforehand to avoid any error and provide maximum accuracy.

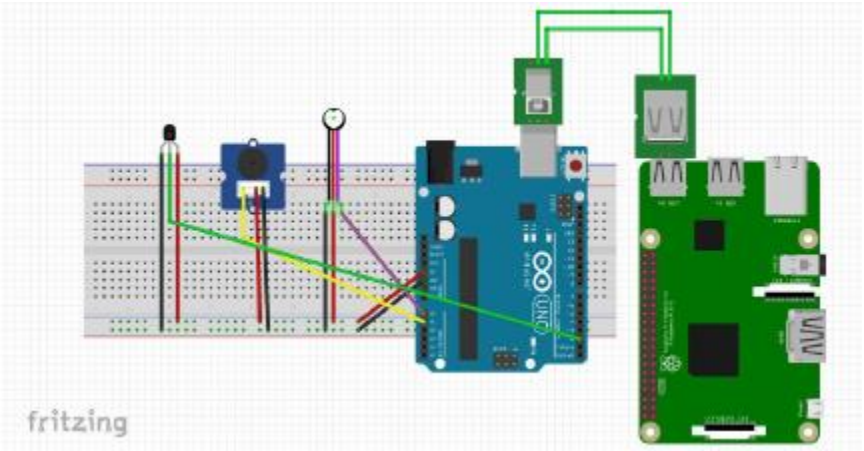
For the software implementation the authors used Google Firebase as the cloud storage which is a mobile and web application platform and to develop the Android application Android Studio was used.

The following was the software architecture of the project

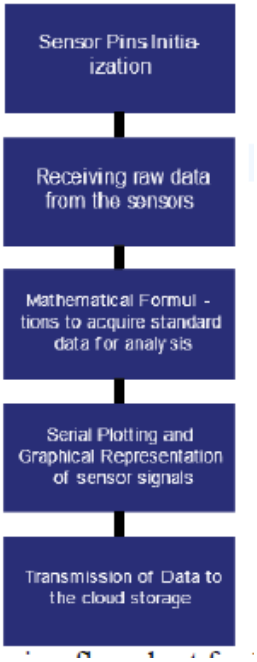


For implementation of the Heart Monitoring System they used the Arduino board, Pulse Sensor and couple of LEDs.The same cycle was applied for galvanic skin reaction. For estimating internal heat level similar parts were utilized.

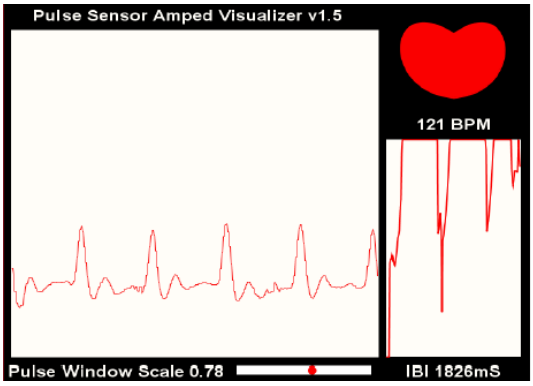
Finally, all the parts were converged into the Arduino Uno alongside the Raspberry Pi and the results were analyzed.



The Raspberry Pi had the following programming flowchart



The best part of the project was the obtained results were analyzed by changing environmental and behavioral factors so see how the sensor will work with changes.



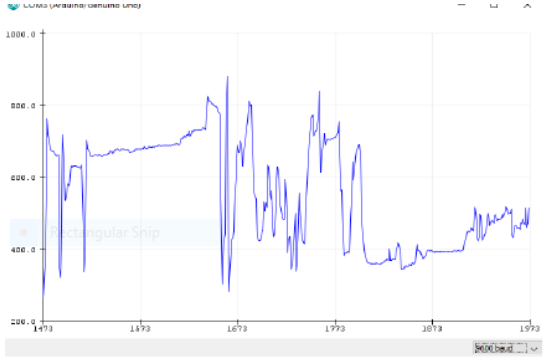
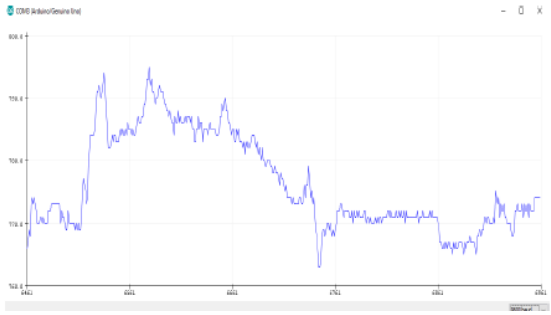
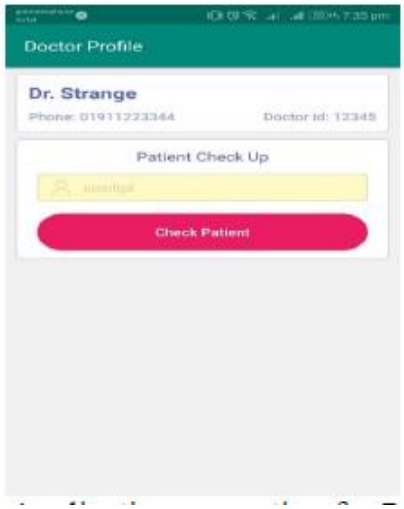
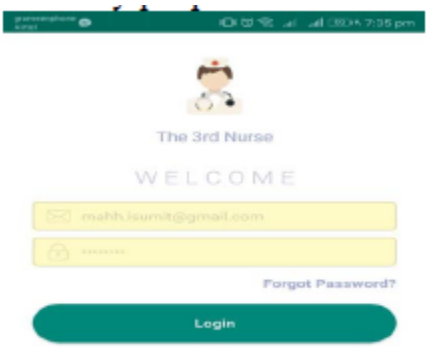


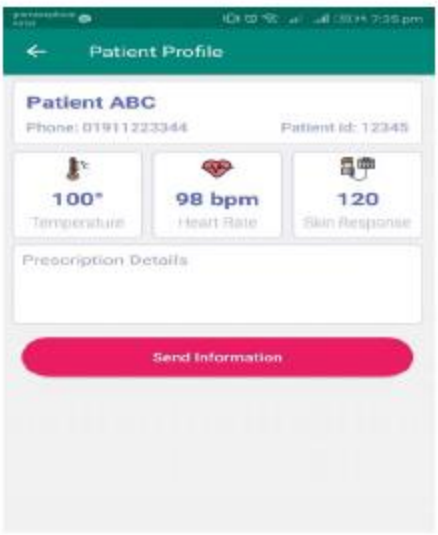
Figure 10: A GSR Signal acquired from a patient showing random variations while putting stress on the skin of the fingers



The last part was developing the Android Application. They kept an easy interface overall. It had three modes of monitoring (Doctor, Personal and Relatives) and for security each of the modes had a unique ID which was permitted by itself. After accessing the patient's ID, the health conditions of the patient can be monitored.







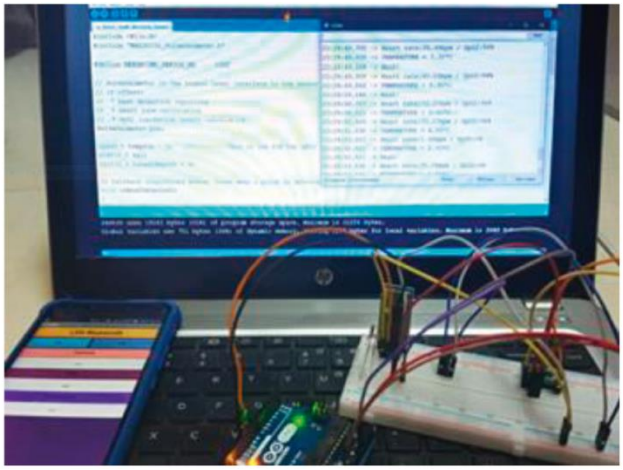
The point of this work was to get a feasible distant health monitoring system for patients. The whole execution framework was intelligently planned with every one of the sensors was adjusted exclusively. Each of the signals obtained from the parameters was analyzed with respect to certain physical activity changes. The fact that the noticed signs make it seen furthermore; their examples were predictable with their general working rule. Overall the project was decent enough to output accurate results.

In [7] M. M. Khan, T. M. Alanazi, A. A. Albraikan, and F. A. Almalki published a paper named "IoT-Based Health Monitoring System Development and Analysis" which focuses to increase the affordability to monitor health factors .The framework measure's a patient's body temperature, heartbeat, and oxygen saturation levels in the blood and the data is transferred to a portable mobile application which gets data over Bluetooth.

The researchers utilized different wearable sensors including max30100 to quantify pulse rate and Sp02 and Lm35 sensors to measure body temperature.

The specialists utilized different wearable sensors including max30100 to quantify beat rate and Sp02 and Lm35 sensors to gauge internal heat level. With the assistance of Bluetooth, the information is received from the Arduino and saved in the cloud and ultimately moved to the Android Application. The Arduino Uno processes the analog signal to a computerized digital signal and the information through Bluetooth is shown in the mobile application. The authors likewise made the accessibility to show the outcomes in a LCD.

The following is the prototype for the Health Monitoring System



As the research centers to build a reasonable device the expense of fostering the entire prototype was kept inside range. The following is the list of the equipment's they used. According to their examination the entire venture cost them (Tk.) 1443, which is under 17US dollars.

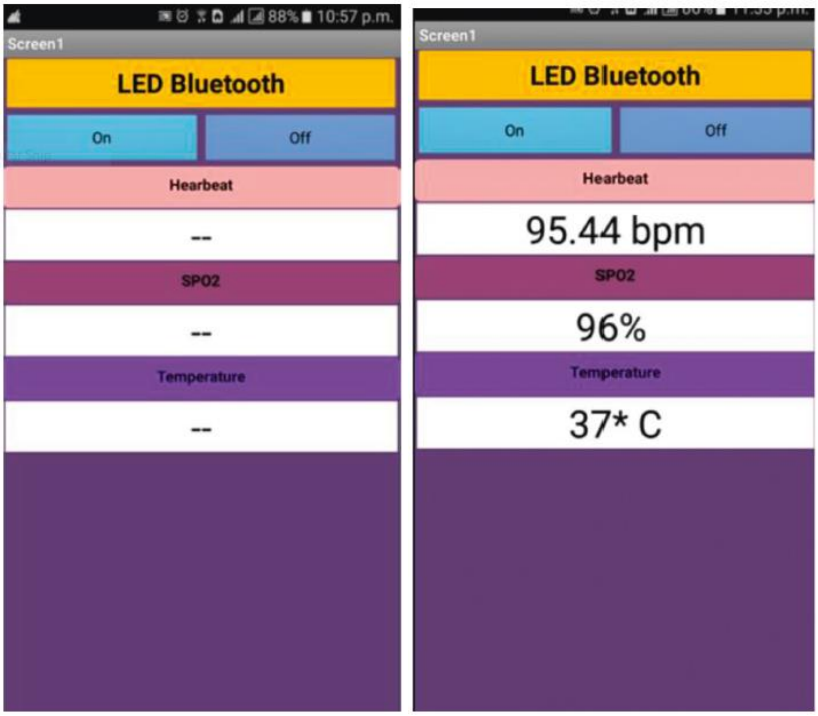
The following is the cost of the hardware materials used in the project

Table 2: Cost of the components.

Component	Model	Quantity	Price/Unit (BDTK)	Price (BDTK)
Pulse oximeter and pulse rate sensor	MAX30100	1	300	300
Body temperature sensor	LM35	1	70	70
LCD display	16 × 2 I2C	1	273	273
Microcontroller	Arduino uno	1	430	430
Bluetooth module	HC-05	1	30	90
Jumper wires		20 × 3	280	280
Bread board		1	85	85
Total cost				1443

For developing the mobile application the author of the paper used MIT inventor App which was then loaded into the mobile device and a link generated for downloading the Application. The Bluetooth was connected to the device through the Scanner. For the Bluetooth module they used HC-05.

The following are the results after running the application



Upon testing the device on subjects, the results obtained for all three health parameters had standardized values.

SpO2	Patient-1 (%)	Patient-2 (%)	Patient-3 (%)
Take-1	97	97	98
Take-2	97	97	98
Take-3	97	97	98
Average	97	97	98

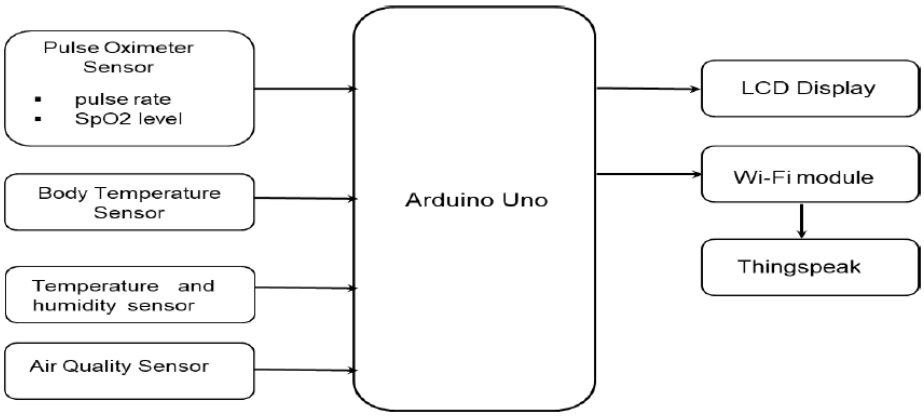
Pulse rate	Patient-1	Patient-2	Patient-3
Take-1	95.26	95.69	93.25
Take-2	95.22	95.78	93.56
Take-3	95.38	95.42	93.10
Average	95.29	95.63	93.31

Body temperature	Patient-1	Patient-2	Patient-3
Take-1	39.20	37.10	36.95
Take-2	39.43	36.95	36.80
Take-3	39.80	37.33	37.20
Average	39.48	37.13	36.98

In [8] Er.Ompal, Shivam R Gupta, Ajay Kumar Pal, Madhur Shukla, and Ajay Kumar published a journal in International Journal of Research Publication and Reviews(IJRPR) titled "IoT Based Patient Health Monitoring System" which assures for an easy setup and a device of high capability for keeping track of patient's health mainly targeting the elderly people and multichallenged people. The primary objective of the project was to design a smart patient's health monitoring system. It deals with sensors that are inserted on the patient body to detect the temperature and heartbeat of the patient. Two additional sensors are set at home to detect the humidity and the temperature of the room where the patient is remaining. These sensors are associated with a control unit, which works out the values of the multitude of sensors. These determined values are then communicated through an IoT cloud to the base station. From the base station the values are then gotten to by the specialist at some other area. In this manner in view of the temperature, heartbeat, oxygen values and the room sensor esteems, the specialist can conclude the condition of the patient and proper measures can be taken.

For the hardware of the project the authors used Arduino Uno as the microcontroller. For measuring the Body Temperature Sensor they used DS18B20, for pulse they used Pulse sensor and MAX30100 as blood oxygen and heart rate sensor. They used DHT-11 and MQ-6 for humidity sensors and air quality sensor respectively. A Wi-Fi module ESP8266 was used as a Wi-Fi module .Arduino LCD screen which accepts the serial input from sensors & uploads the sketch to the Arduino. The library that allows us to control the LCD display is called Liquid crystal library along with a normal buzzer to create sound.

The following is the block diagram of the proposed system



.

The block diagram reflects the data collected through sensors are sent to the Arduino Uno and are stored in the Thing Speak cloud through the internet. A pulse sensor measures heart pulses, and helps to determine the heartbeat of the patient. Similarly, all sensors are connected with Arduino. To add a bridge between the patient and doctor, a Thing Speak server and a web portal are introduced. The Wi-Fi module (ESP8266) is connected to the Arduino enabling the patient's data to be stored in the IoT interface using the local internet. LCD display is used to show real time values to patients and its caretakers. A buzzer starts beeping if it encounters any abnormal conditions and a SMS is sent to a predefined mobile number set on the Application. By coding the microcontroller the sensors are interfaced with the Arduino Uno. Power is supplied via adapter or battery. A charge controller has been connected for minimizing excess voltage to control the power supply.

The following are the results after running the application

LCD SCREEN SHOWING HEART RATE OF BODY BY PULSE SENSOR

LCD SCREEN SHOWING TEMPERATURE OF BODY BY LM-35

Overall, the project is can be truly valuable when we really want to record, screen and monitor changes in the wellbeing boundaries of the patient. In the Internet of Things based patient observing frameworks, a data set of the health parameters can be kept up with. This will assist the specialist with effectively tracking down the progress in the wellbeing boundaries or history of the patient while proposing the treatment or medication for the patient

In [9] Thierry Edoh and Jules Degila published a journal on "IoT Enabled Monitoring and Assistive Systems for In Place Aging Dementia Patients and Elderly". The goal of the review was connected with the proof that the authors found which included progressed dementia patients requesting monitoring round the clock for simplest activities.Therefore,they opted for telemedicine to take care of the issue. This paper for the most part centers around proposing a brilliant home automation system that will be financially affordable and furthermore the authors surveyed the QoL(Quality of Life) of all including family members. The fundamental targets behind the examination questions are on one hand to research the propensity toward homecare in regards to the nursing care homes and care labor force deficiency and then again to also explore difficulties and issues individuals are looking in homecare. The requirements as far as suitable solutions for conquering the difficulties and issues faced by caring patients in homecare are also assessed.

The authors mainly asked 6 questions:
1) What is the tendency for homecare regarding the current nursing care crisis?
2) What challenges and issues are patients facing in homecare?
3) Is it worth caring for dementia patients in homecare instead of at nursing?
4) What is the quality of life (QoL) of patients treated in homecare?
5) How to assess the factors impacting the health-related QoL for homecare?
6) Can the technology assist to overcome homecare-related challenges and issues?

The hypotheses the study focused on are the following:

H1: The tendency to care for patients in homecare increased since the nursing crisis.
This study also verifies if the nursing crisis has impacted the family member's behavior.

H2: Smart automation home technology assists in homecare and impacts the QoL of both family members and the patient.

H3: Smart home automation enables to combine occupation (job) and caring adequately (efficiently and effectively) for a patient at home.

The methodology the authors of this paper utilized for data gathering incorporated a semi-organized interview. The interview included individuals/patients residing at home, nursing care, the stuffs working at a nursing care and irregular individuals on streets. The data collection was anonymous so information protection was there. The strategies in information assortment had questionnaires which were yes/no inquiries and liberal questions. Mostly the patients who resided in nursing homes and the nursing home staffs were interviewd.For the analysis of

information IBM SPSS measurements were used. They likewise had the ethical approval of the patients who were being evaluated.

Coming up next is the questionnaire for the patients:

Pos.	Questions	Observations
1	What do you most of all miss here?	Check how many patients prefer staying at home instead of living at the residence
2	Do your relatives visit you?	
3	How often do your parents visit you?	
4	Do you have any close friends here?	Socialization measurement
5	Are you missing your former friends?	Socialization, if he misses his former friends, this means he does not find a one here
6	Do you miss your parents, children, and grandchildren?	If yes, it means he does not receive enough or regular visits
7	Do you like living here?	
8	Do you have enough space for you?	
9	Are you missing your home?	
10	Do you receive enough and regularly food and water?	
11	What did you eat today?	Check if he is forgetful in order to consider or not the responses above
12	How do you feel today?	Assess the quality-of-life related to the patient's health state and care services he is provided with
13	Are the nurses nice to you?	
14	Which nurse is your best friend?	

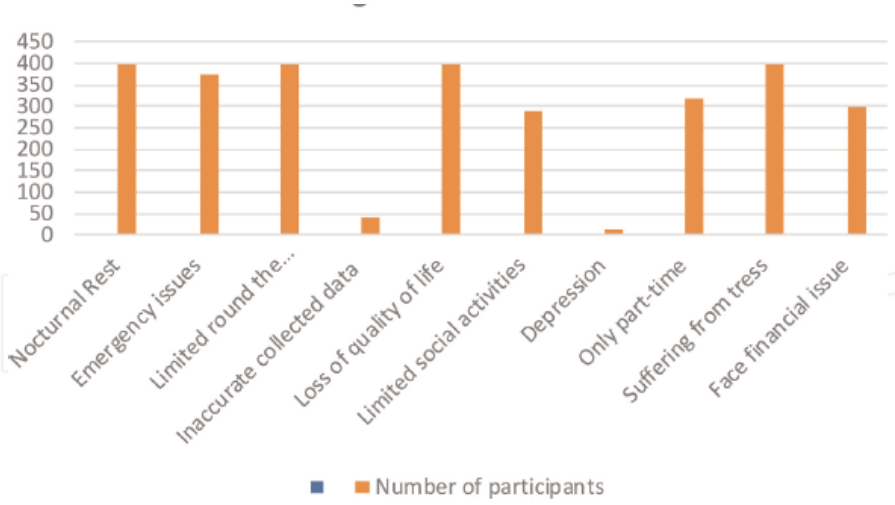
In the literature review part, what the authors did was they reviewed 239 journals and they found out two papers that discussed many dimensions of smart homes. They reviewed all the systems for lacking and incorporated their findings in the proposed system. The interview findings with nursing home residents revealed that elderly people prefer staying in their home who have homes whereas the poor or homeless are forced to stay there.

The following picture points out one of the results of the survey they conducted

Category	Social status	Number	Preferences	
			Living at nursing care home	Staying at home
Nursing home residents (33 participants)	Poor family support Poor (financial) Have lived alone	21	17 (85%)	4 (15%)
	Rich Good family support Good social contact	12	01 (8.3%)	11 (91.7%)
Homecare participants (30 participants)	Living alone	23	21 (91.30%)	2 (8.70%)
	Living with family	7	0	7 (100%)

The best part of the paper was that they listed all the necessary reasons why elderly people chose nursing residences and the paper has more weight as they conducted field research.

Besides they also listed the Challenges and Issues patients faced while conducting the research. It helped them include the missing elements in their proposed system.



The following diagram shows the comparison of patient's quality of life before and after applying the proposed method for data collection:

Pos.	Metrics		N= 30 (Test last 2 weeks)			
			Number (%)			
			Before the test (AVG of 5 days observation)		After the test (Data provided by the system)	
			Have met the metrics			
			YES	NO	YES	NO
L1	Food and Water Intake		12 (40%)	18 (60%)	22 (73,33%)	8 (2,66%)
L2	Medication Intake		17 (56,6%)	13 (43,4%)	23 (76,6%)	7 (22,4%)
L3	Physical Activities		4 (13,3%)	26 (86,7%)	11 (36,6%)	19 (62,4%)
L4	Socialization		3 (10%)	27 (90%)	13 (43,33%)	17 (56,6%)
L5	Room Temperature management		3 (10%)	27 (90%)	26 (86,7%)	4 (13,3%)
L6	Noise and Lighting control		2 (6,6%)	28 (97%)	7 (22,4%)	23 (76,6%)
L7	Accident rate		1 (3,3%)	29 (26.7%)	1 (3,3%)	29 (26.7%)
L8	Good Emergency management		5 (16,6%)	25 (23,4%)	15	15
L9	Bio-signal gathering and data quality		1 (3,3%)	29 (26,7%)	18 (60%)	12 (40%)
L10	**Results**	Quality of life	Mediocre		Good++	
L11		Health outcome	Good-		Good+	

Legend (Comparing before and after test data)

Good++	
Bad	
Unchanged	

AVG	

The quantitative outcomes in regards to difficulties and the quantity of individuals that detailed these difficulties and issues by caring for a family member are summarized. The quantitative information examination uncovers that not many individuals in home care are confronted with information collection issues. This implies information is seldom gathered in home consideration. Consequently, patients lying at home don't create patient-driven information. The couple of information there produces shows restraint focused. It is however realized that patient-focused information are abstract, deficient, and at times one-sided. The paper likewise had tables and figures that showed what family support means for patients QoL.

Lastly, the authors discussed the concept of multi-dimensional smart home automation using Internet of things for assisting dementia patients. According to them, the framework design should incorporate Nutrition level, Medication adherence, Physical activities and socialization level, Family support and Space and Comfort ranging in activities like Food and water intake monitoring, Medication intake monitoring, Physical activities like TV programs to help patients train themselves, Room temperature Monitoring, Windows and Door Monitoring, Noise and Lighting control, Reminder and assistance for indoor and outdoor.

For measuring the QoL of a patient the following metrics were defined:
1) Assessing the QoL of a patient both qualitatively and quantitatively.
2) Providing daily living assistance.
3) Supporting patient empowerment and autonomy.
4) Positively impact patient's health outcomes.
5) Collection of Patient-Centric data and information.
6) Assisting family members for taking care of the sick at home.

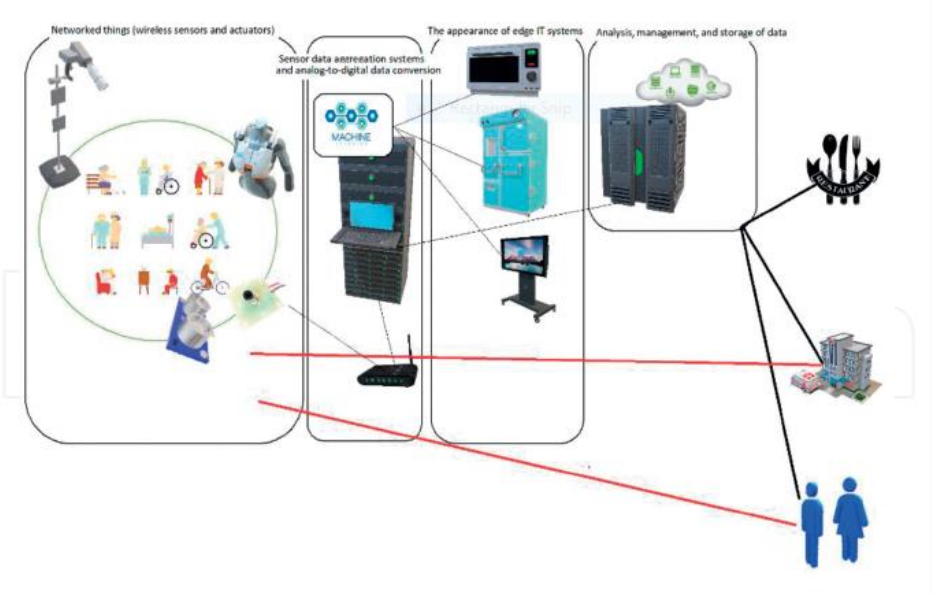
The fundamental system significant prerequisite is to give patients a less expensive, basic, and better convenience by considering their cognitive impedance like eye, hearing, and feeling impedance, confined development, and so forth. Moreover, the proposed arrangement ought to work on the online and offline.

Based on the requirement above, the authors proposed system provides a patient centric data collection with sensors connected with the patient that collects any bio-signal as well as and sends the data to a record system at the remote. A duplicated copy of the data is saved on the local server as well. Furthermore, a set of video recorders are used to collect the patient's body expressions and any physical activities. These data are also used by the ML algorithm to predict patient's behaviors, expectations, and physiological needs like thirst, hunger, going to the toilet, etc. The sensors eventually connect the patient to an IoT-gateway that transfers the collected data, using the MQTT protocol, to the local server. Collected data are stored in the local server which is sent to the cloud using CoApp.Medical officers and family members can access the data.

For "food and water intake", a smart device is designed which deals with all the reminders and where the food is at home.
For medication intake monitoring a drug dispenser is provided which is connected to the IoT-gateway via Bluetooth. It features an alarm and can remind the patient to take his medicine. The medication intake is logged and a protocol is stored on the network. It also has the facility to inform members of the family if the patient doesn't take the medicine on time or might have forgotten to.

For physical activity monitoring which includes activities like watching television the local server is connected to a touchscreen TV. It can display physical activity programs, which can let the patient to also do so, for example, activities like a walk in the room etc.
Elderly people need real socialization which includes outdoor activities. Therefore they need to go out and meet other people. This is obtained by featuring a smartphone-based application that manages and looks for senior-meeting close to residence place. It also has the Google Maps integrated which will help the patient to and fro the home. It can also be used if the patient wants to go for a medical visit.

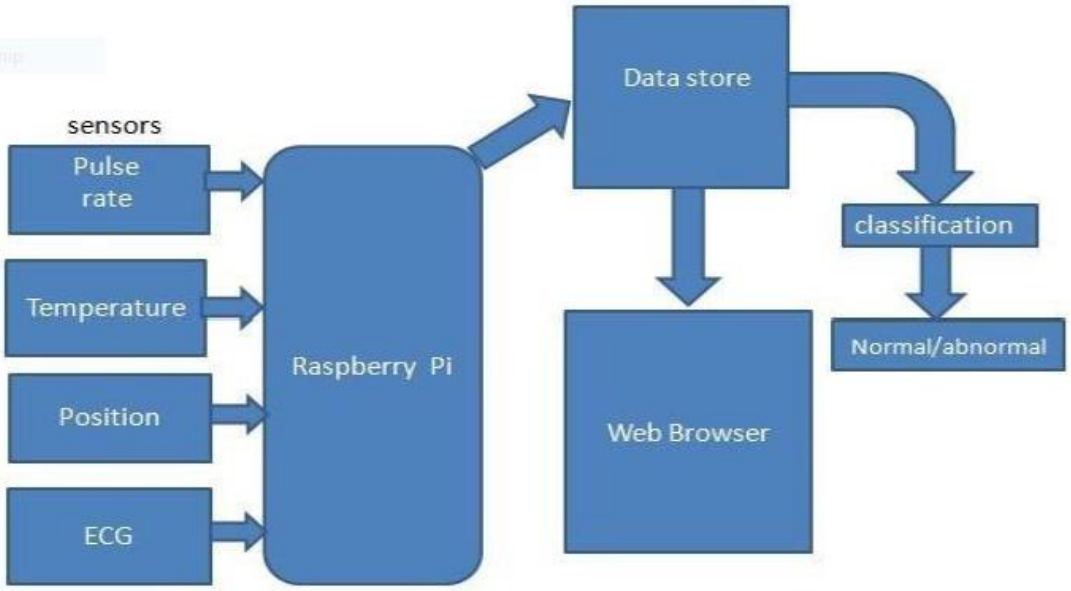
The following is the architecture of the proposed system:



This study has examined the cutting edge of "ageing well at home." Numerous past investigations had documented fascinating chips away at making the "home" agreeable also, more intelligent for old and dementia patients. However the greater part of the past works has flopped in giving a total arrangement of brilliant home automation system. This study covers this limit and shows that brilliant home automations affect the patient's and his relative's QoL in a positive manner. Individuals remaining alone at home as well as those residing in nursing care homes would take benefits from such a proposed system.

In [10] Dr.Suvarna, Nandyal, Roopini U kulkarni, and Rooprani P published a journal on “Old Age People Health Monitoring System using IoT and ML”.The proposed project aims to provide health model to monitor patients 24*7 using wearable sensors and IoT. The authors focused on parameters like Electrocardiogram (ECG), Pulse rate, Temperature and Position. The following parameters can be monitored on any mobile devices, laptops or phones. From the sensed data, they used Machine Learning to analyses the data to provide the status of health of patient.

The following is the system architecture of the proposed project:



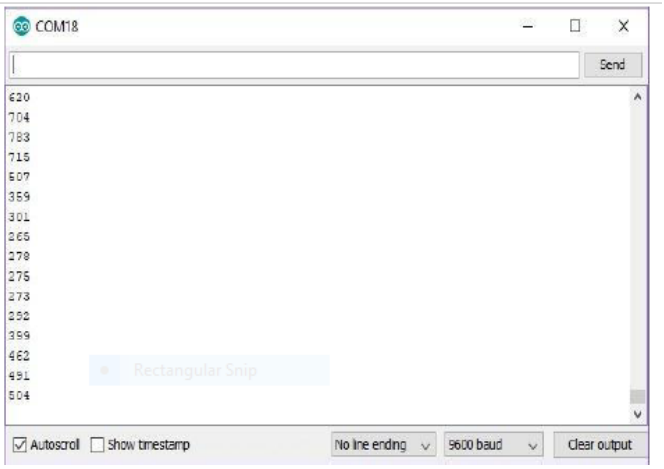
The input units consisted of the sensors which were wearable and can be connected to the patient's body. The sensor extracted values can monitor on a web page that monitors the health condition of the patient. Machine Learning is used to identify normal and abnormal state of patient. The values from the sensors are sent on the web page which can be monitored by doctors and family members. To identify between normal and abnormal values a threshold value is set.

The authors used Raspberry Pi for transfer of data. For ECG they used AD8232 and for position sensor they used ADXL335.DS18B20 was used as Temperature sensor and a Heartbeat sensor with probe was used for measuring heartbeat.

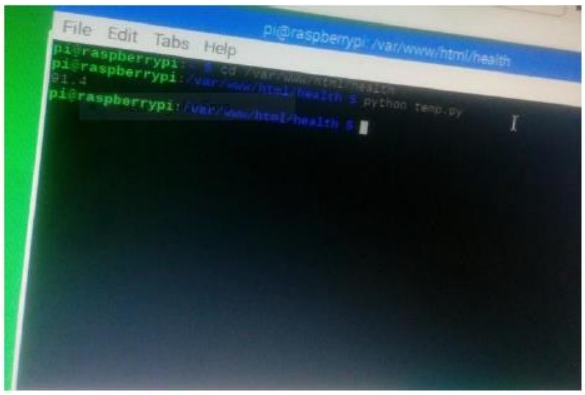
As results analysis they obtained the following results

i) ECG analysis serial plotter

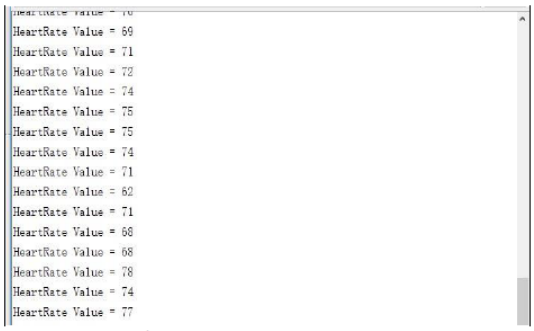
ii) Output ECG Serial Monitor



Iii) Temperature sensor output



iv) Heart rate sensor output



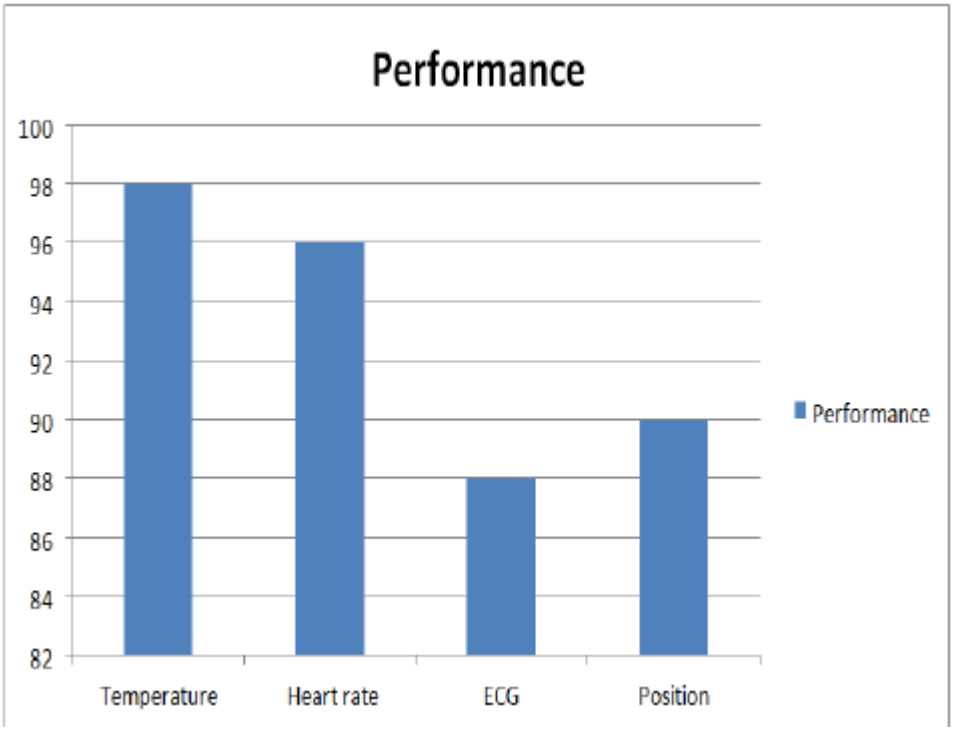
The authors of this paper applied this health monitoring system to test 15 patients and the results are as follows:

PATIENT	TEMPREATURE in centigrade	HEART RATE	ECG	POSITION	CONDITION
1.	36.6	96	460	LEFT/YES	NORMAL
2.	37.7	98	461	RIGHT/YES	NORMAL
3.	36.7	99	458	RIGHT/YES	NORMAL
4.	37.0	65	436	RIGHT/YES	NORMAL
5.	36.8	75	437	LEFT/YES	NORMAL
6.	37.2	85	460	LEFT/YES	NORMAL
7.	36.9	95	461	RIGHT/YES	NORMAL
8.	37.3	115	458	RIGHT/YES	NORMAL
9.	37.1	125	437	RIGHT/YES	NORMAL
10.	37.3	135	438	LEFT/YES	NORMAL
11.	37.5	145	456	LEFT/YES	NORMAL
12.	37.4	160	429	RIGHT/YES	NORMAL
13.	37.6	120	460	LEFT/YES	NORMAL
14.	38.2	110	0	RIGHT/YES	ABNORMAL
15.	35.2	99	40	RIGHT/YES	ABNORMAL

The researchers of this project opted to increase awareness for the health conditions so that patients can see the doctor in due time. They used ML for detecting abnormal conditions.Minicoda software and scikit learn package was used in python for this section where stored sensor data from database is collected based on the condition as normal or abnormal is then specified.

Moreover the performance of the proposed system was up to the mark.

The following bar chart shows the performance for each health parameters:



The proposed system is effective in real time system. But it can be extended with other health parameters of old age people which will make it more beneficial for elderly people. And based on health parameters of old age people machine learning can be done, disease that may occur can be known before.

In [11] Somayeh Iranpak, Asadollah Shahbahrami, and Hassan Shakeri published a journal on "Remote patient monitoring and classifying using Internet of Things platform combined with cloud computing'. In this paper, a prioritization system is used to prioritize sensitive information in IoT, and in cloud computing, LSTM deep neural network is applied to classify and monitor patients' condition remotely, which can be considered as an important innovative aspect of this paper. Sensor data in the IoT platform is sent to the cloud with the help of the 5th generation Internet. The core of cloud computing uses the LSTM (long short-term memory) deep neural network algorithm. By simulating the proposed method and comparing the obtained results with other methods, it is observed that the accuracy of the proposed method is 97.13%, which has been improved by 10.41% in average over the other methods.
The authors of this paper used LSTM deep neural network are used in this paper to remotely classify and monitor the condition of patients. Data and information about the patients' condition are provided via sensors in the IoT and 5th generation Internet to cloud computing and as an

input to the LSTM deep neural network. The LSTM Deep Neural Network is based on trained input data and produces a model based on hidden layers and neural structure. Then it receives information about patients 'status for classification and evaluation and uses the generated model to classify and monitor patients' health status remotely. [12]

The following figure shows the architecture of the proposed method.

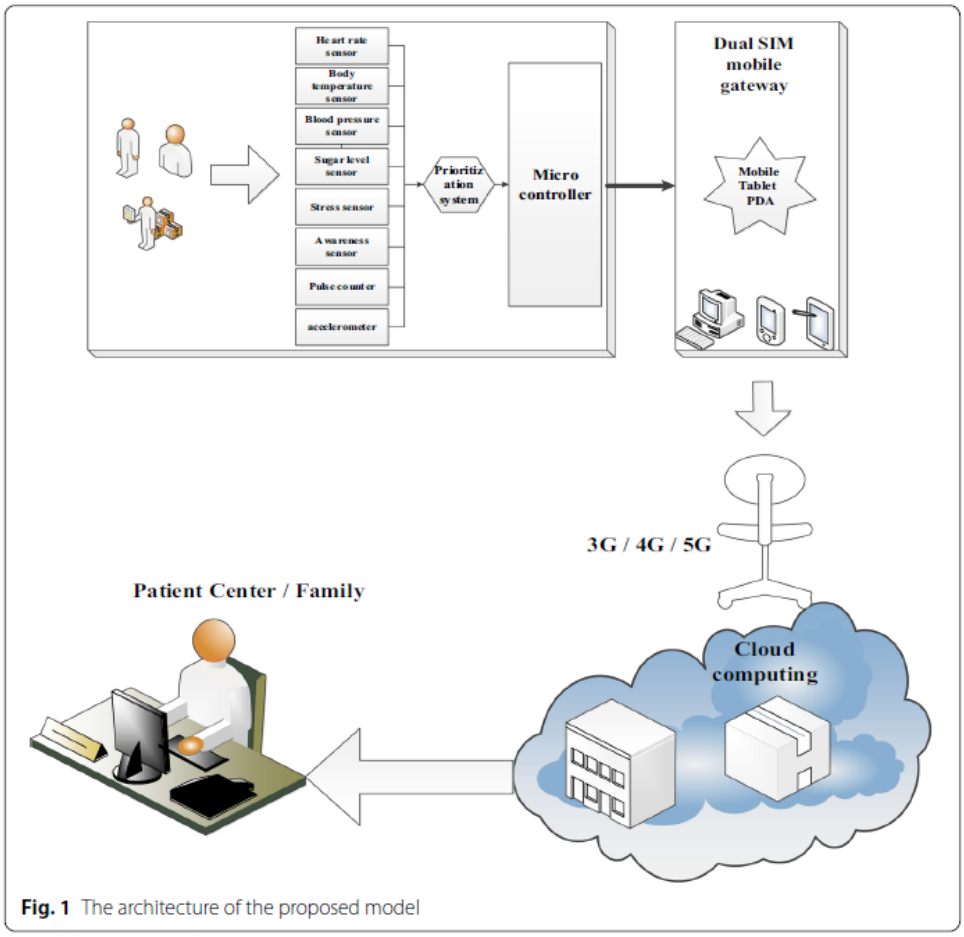


Fig. 1 The architecture of the proposed model

These authors used 8 different kinds of sensors. Heart rate sensor, Blood pressure sensor, Body temperature sensor, Blood sugar level sensor, Stress level sensor, Consciousness level sensor, Pulse counter and Accelerometer.
The microcontroller is used to monitor the parameters of the sensors and as an interface to send the information from the patient to the mobile gateway. In the next step, the encrypted information is sent from the microcontroller to the mobile gateway via Wi-Fi or Bluetooth. Another option to access through two SIM cards is provided, if the transmission of information faces problems, or one of the SIM cards does not work properly, the other SIM card starts working and the process of sending information continues. [13]

The following is the accuracy of the proposed model

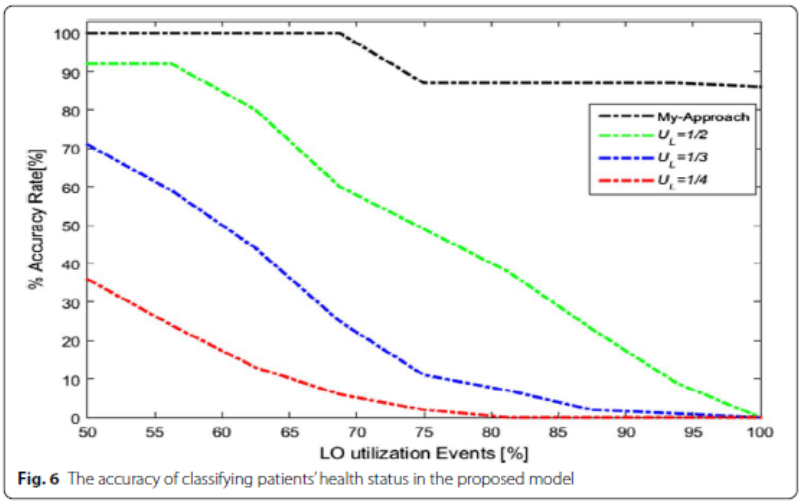
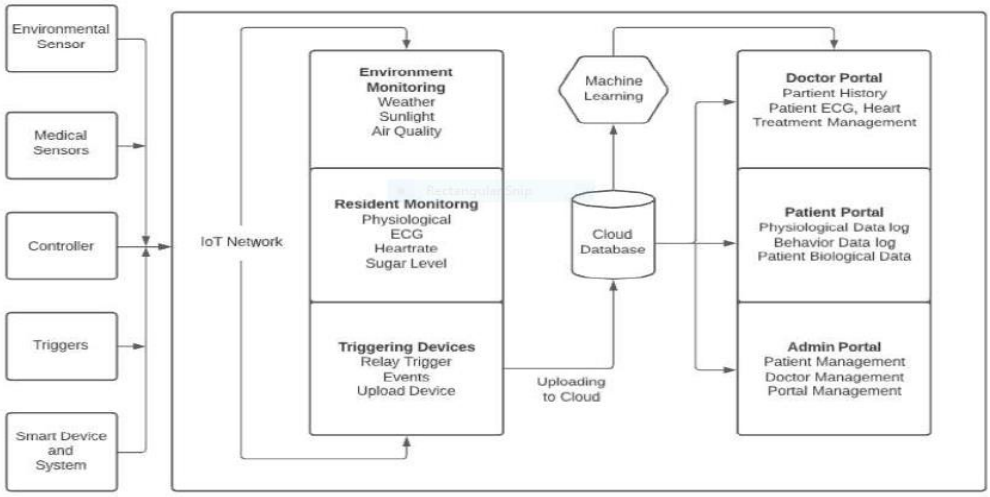


Fig. 6 The accuracy of classifying patients' health status in the proposed model

In [14] Pratik S. Kayate, Prof. A. B. Deshmukh, and Prof. M. D. Tambakhe focused mainly to reduce the number of elderly deaths resulting from late diagnosis. Their proposed system is used for Disease risk prediction using Data and CNN Algorithm. It can predict most of the chronic diseases. It accepts structured data as input to the machine learning model. This system is used by end-users i.e. patients/any user. In this system, the user enters all the symptoms he or she is suffering. These symptoms will be given to the machine learning model to predict the disease. Algorithms which are applied give the best accuracy. Then System then predicts the disease on the basis of symptoms. This system uses Machine Learning Technology. Naïve Bayes algorithm for predicting the disease by using symptoms, for classification KNN algorithm is used and Logistic regression is used for extracting features which are having most impact value. The Decision tree model is used to divide the big dataset into sub parts. The final output of this system will be the disease predicted by the model.



The first step for the user is to sign-up with valid credentials and then then they can login and in the login page they can see tall medical history.Admin of the system gets an automated system management via admin dashboard, which gives manage patient option to the admin. A doctor can track down all the dedicated data and the previous history of treatment for that particular user, as the KNN algorithm determines the accurate chronic diseases.

The following Figure 5 is the Patient Login window which been used to log in the user as a patient or incase if the patient is not registered with the HMS then he/she can create their new account. Following that Figure 6 – shows a patients list about the system registration to the admin as it maintain all users list with the action tab to the particular patient with that it can easily manage all the terms and the Patient + Doctors. Figure 7 shows the patient medical history by what the patient previously treated so their complete treatment record by particular so no need to maintain paper records. Figure 8 deals with history details about the history of particular treatment with ECG maintain value or heart rate value and glucose level in blood. Overall, average prediction accuracy probability of 100% is obtained by the authors of this paper. Besides, as the system is based on the web application, the user can use this system from anywhere and at any time.

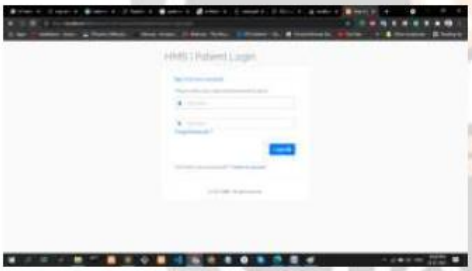


Figure 5: Patient Login

Figure 7: Medical History

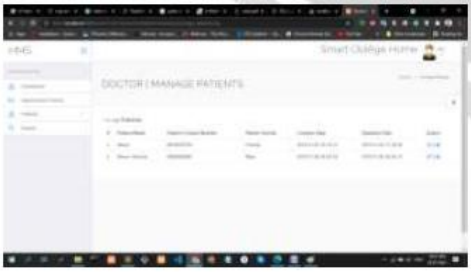


Figure 6: Manage Patient

Figure 8: Treatment Record

III. PAPER ANALYSIS

References	[3]	[5]	[7]	[8]	[9]	[10]	[11]	[14]
Elder population	✔	✔	✔	✔	✔	✔	✔	✔
Sensors/microcontroller	✔	✔	✔	✔	✔	✔	✔	✔
Sensors at home for base values					✔			
Cloud storage	✔	✔	✔	✔	✔	✔	✔	✔
Wi-Fi/Bluetooth module	✔		✔	✔	✔	✔	✔	✔
Cellular Connectivity							✔	
Web portal	✔			✔			✔	✔
Android Application		✔	✔			✔		✔
Power supply via adapter/battery	✔	✔	✔	✔	✔	✔	✔	✔
Minimizing excess voltage				✔				
Alert buzzer				✔				
SMS alert	✔			✔				
Identification of normal and abnormal state of patient						✔		
						✔	✔	

Real-time accuracy graphs								
Medical history storing function					✔			✔
Machine Learning techniques					✔	✔	✔	✔
Wearables					✔			
Fall detection system	✔							
Sensor analysis in different environment		✔						
Unique ID for security purposes		✔						
GPS					✔			
Field research						✔		
Tested on subject							✔	

Table 1: Comparison of methodologies used in the related works (2019-2022)

IV. IOT HEALTHCARE CHALLENGES AND ISSUES

IoT innovation has braced clinical consideration information support with powerful network, high availability, and further developed stockpiling capacity, and for that reason its piece of the pie is expanding. However, healthcare sector faces multiple challenges in its adoption, and those constraints don't let IoT utilize its maximum. In this context, we discussed all the issues and challenges related to IoT based Health Monitoring which should be incorporated in the existing projects to make them more secure.

A. Security

Iot based devices captures colossal measures of data, including sensitive information leading to the worries about data security. Data protection and Information Security are the most eminent open issues of IoT based Healthcare Systems. As IoT gathers and catches data, the information is put away and moved routinely which may be utilized by hackers to utilize it against patients. Hackers could recreate the patient ID to purchase tranquilizes or do unethical stuffs. Therefore, the architecture of IoT doesn't give a lot of safety and protection of personal data.

B. Data Protection

Data Security in the medical services application is a developing issue with a rising number of breaks of the Information Security. Hackers attempt to hack information to use it against patients and specialists. Both patients and Doctors are susceptible to data breaching issues. Private hospitals facilities perceiving these dangers and overhauling their visual security to safeguard their private on-screen information and stick to the securing data .

C. Cost

Clinical patients are increasing at an alarming rate around the world that is expanding the utilization of IoT based devices decisively over the most recent few years. The interest for IoT gadgets in updating and the expense is likewise expanding. Starting from the cost of microcontrollers to expensive sensors cost examination is an open issue in the IoT based Health Monitoring Systems. Besides, the expense of getting IoT based medical care is as yet not attainable for ordinary population.

D. Power Consumption

IoT based medical devices needs a lot of power. They have to be connected to the internet all the time to produce data in real time. Besides some of the sensors used might require and consume a

huge amount of power. Considering the recent power crisis, the power consumptions is an open issue for IoT based devices. If the energy infrastructure of the world collapses the IoT based Healthcare devices will collapse as well. Therefore, the vendors must come up with something that will reduce the power consumption of IoT devices.

E. Quality of Services (QoS)

Health is a matter of life and death. Thus, the quality of IoT based Health devices must be of the highest accuracy and available 24/7.All the devices must be proven reliable.Sometimes,the sensors used in collecting data fails to provide information on time which might be a factor of degrading QoS.It is very important to mitigate such problems.

F. Limited Bandwidth and Connectivity

Network failures aren't acceptable in devices that require real-time access to data, as many medical devices do. Maintaining connectivity is especially challenging in mobile devices like wearable's, which travel anywhere the patient does, across borders and coverage zones. Most of the IoT devices rely on connectivity over Wi-Fi which might not always be available. Therefore, the cellular network becomes the primary need. Along with it, the cost of connectivity will also increase when the amount of devices becomes dense. [15]

G. Lack of skilled professionals

There are inadequate numbers of trained IT departments who fail to handle the large influx of devices during implementation. The training received is not often up to the mark. Sometimes, incompetency in implementation is not the problem. IT departments in a healthcare organization often excel at the implementation task. What causes the problem is when large-scale deployment takes place, the workload on IT personnel increases, and managing safety, security, and maintenance becomes challenging. [16]

H. Integration with Legacy Systems

Integrating multiple types of devices often hinders the implementation of IoT in healthcare. The reason behind this barrier is that device manufacturers have not reached a similar ground for developing protocols and standards for communication, as said earlier. Manufacturers construct their devices in isolation from others and within their own ecosystem of IoT. This results in their devices being unable to work with legacy healthcare systems and applications. [17]

V. CONCLUSION

The area of health sector has been developing persistently for the advancement and improvement of patients. Researchers and Scientists have been working persistently by using the most recent advancements to carry this improvement to the health sector, and wearable innovations have been a famous worry among them throughout the long term. This paper addresses different IoT projects that have been implemented in different ways for well-being of patients targeting mostly Elderly people who reside in the remote areas. Besides, advances in wearables could be improved further to address the issues of patients successfully. A more noteworthy number of sensors could be coordinated like respiratory rate sensor, circulatory strain sensor, and blood glucose sensor. Adding these sensors could give the customer a complete package of Health Monitoring System. Furthermore, it's also possible to implement Machine Learning/Deep Learning and Artificial Intelligence keeping in accordance with present day wearable. Not just it will diminish the pressure of emergency clinic visits, hospital expenses, yet in addition foresee the chance of serious sicknesses ahead of time which could save lives. This sounds significant development to this work and would make an enormous reasonable effect on the health sector. Since clinical issues are being examined, it would significantly benefit the application on the off chance that deliberate sensor values could be moved along. There's more scope of research and improvement in this topic.

VI. TIMELINE

Project Timeline	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7
Requirement Analysis							
Planning							
Paper Analysis							
Paper Comparison							
Final Report							

VII. CONTRIBUTION OF INDIVIDUAL MEMBER

	Requirement Analysis	Planning	Paper Analysis	Paper Comparison	Final Report
Ishrat	50%	50%	50%	50%	50%
Nowsin	50%	50%	50%	50%	50%

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