

# AN EFFICIENT AI BASED FRAMEWORK FOR MONITORING AND SUGGESTING FOOD CONSUMPTION

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## ABSTRACT

*Emerging technologies like Artificial Intelligence, Machine Learning, Blockchain are facilitating the medical healthcare sector in numerous ways. This artificial intelligence-based framework is designed for controlling the fitness of humans in the consumption of food intake with respect to physical work. The proposed framework is designed for controlling and monitoring the diseases based on the lifestyle of the individual. By using this framework, especially a diabetic or obese man who is neglecting food consumption and physical exercise. This framework will store all the exercise with calories burnt time-wise during the day through the smart IoT-based watch proposed in this framework. It is also storing the food eaten, juices intake, or water intake through the camera hanging in the neck. Artificial Intelligence is used to provide suggestions for avoiding the specific intake of food observed by the framework via the camera in the locket. The calories burnt through physical exercise done by the human being through the various sensors like a gyroscope for steps etc. The paper tried to provide suggestions based on the intake of the individual for the energy consumed by the foods and the outcome by the work outperformed by the various exercises and energy burned with the help of the band embedded to the wrist of the individual.*

**Keywords:** *Internet of Things, Arduino, Wi-Fi, Cloud Computing, Big Data Analytics, Disease, chronic, Non-Communicable, Framework, Artificial Intelligence.*

## I. INTRODUCTION

The human being is a smart organism having a control over the nature after deep observations and researching over the billions of the processes related to living world. Human being is smart enough and developed almost everything smart and himself became the slave of these smart technology. The human has developed the smart phones and now no any human is left without addiction of the smart phone. Starting from the study to business to the entertainment or games, the smart devices are the backbone for these activities. Keeping this trend, the human being has developed some new type of diseases from these smart devices, the kids are in-born smart phone users. On the one hand the technologies are touching the heights, on the other hand, the new diseases are also competing in the same tradition. The COVID 19, the pandemic of the corona virus, was the incident which badly affected the positive accelerated trend of the technology. The medical science needs to be spread among the human beings to avoid such small and silly activities which can lead to the disaster in the future. So there is a huge gap between the natural life and the artificial life created by the use of the smart devise in the present era. There is a great need of understanding the nature. Human being is very much interested in the business

activities, increasing their wealths by numerous methods, but on the other hand if some medical related activities like yoga is advised, the behaviour of the human being is adversely redacted. This research paper istried to study the behaviour of the human being, analysed the factors effecting the nature and proposed an efficient framework to spread awareness about himself with the nature of work carried out in context of other parameters like age. In the proposed framework, the interactive database is designed for storing the information related to the individual. The daily activities are stored in the database along with the intake of the food items. The IoT devise like smart watches, smart bands, lockets, etc. are the devices attached to the human being individual for storing the various activities performed by the individual.

## II. REVIEW ANALYSIS

A few IoT related devise are already in the market which are embedded with various sensors and actuators with network like wifi, Bluetooth, RF etc. and working in the automatically mode, requires no any human medical assistance for monitoring or controlling such devices, all the devise are connected to the central place at the cloud storage and the web based APIs are the main tools joining them with the central storage for storing and analysing the various inputs taken from such instruments. A few among such devices are as follows:

- Medicine relief reminders
- Medical Data transferring.
- Vital signs data capturing.
- Drug Effectiveness Tracking
- Air Quality Sensors
- Remote Temperature monitoring for vaccines
- Remote Care biometrics scanners
- Sleep Monitor

### Benefits of the above IoT Devices in the healthcare quality:

- 1) **Transmission of Medical Diagnostic Data:** IoT devices plays a vital role in the speedy transmission of the diagnostic information of the medical including uploading the data of the patients like physiological conditions, reports and other medical related information.
- 2) **Monitoring and Virtual Visits:** Due to COVID 19, pandemic situations, the physical visits were as constraint in the medical scenarios, the use of IoT devices and the smart phones for virtual conferencing, the doctors and patients interaction became much easier.
- 3) **Optimized pharma production:** The IoT devices helps the pharma production in the optimised way, the IoT devices connected use in lab-scale testing of the raw materials reduce wastage by quality control for the smooth production at the reduced costs of the medicines.
- 4) **Mobile Sensing:** The camera sensing device is very useful for collating useful information about the situation of the patient, their diagnostic reports and remote consultations.
- 5) **Therapeutic Devices:** These are the devices which are in the single or the combination of the other devices, to support, replace or restore the bodys biological functions or alleviate any illness or injury e.g. wheel chairs, sensory aids, artificial limbs etc.
- 6) **Lower healthcare costs:** At the bottom line, we can say that the IoT devices helped the healthcare in promoting the quality at the even lower cost [1] and thereby serving as a key enabler to sustain health-care delivery [2]. IoT can revolutionize the healthcare by facilitating it in the efficient and effective way for treatment especially in the chronic disease management like diabetes, cardiovascular ailments, cancer etc.

IoT Device provides a more comprehensive approach to health care, especially for patients with chronic conditions [3]. After a study on related work and literature reviews on the usages of IoT Devices/ Technologies for improving the healthcare in general [4] [5] and observed on the basis of the relevant literature and find the emerging technologies using the IoT for chronic disease management, compilation of the achievements of the research works focusing on the use of IoT for chronic disease management. There exists a lot of IoT based

researches in the literature of IoT Technologies for chronic disease management were reviewed to determine the dimensions that help provide an overview on the available literature [4] [6] [7] [8] [9] [10] [9]. Cloud Storage/Cloud computing facilitates portability in wide usage of IoT devices for monitoring the health of patient by centrally storing and collecting information through IoT devices at the cloud Storage where further data analysis and predictions on the based of the historical data can be performed for a best decision making [11].

There exists several IoT device with applications like Saravanan et al. developed a secure mobile device for monitoring the diabetic patients with the blockchain technology for the security aspects and trusted access to the collected data [12]. The literature for drug identifications like in [13] [14] ,Jara et al. presented a drug identification system and delivery using the ontology & IoT technologies, in which the ontology describes the concepts of drug and patient's information and IoT Device helping in identification of the drugs through radio-frequency identification (RFID), near-field communication (NFC), or similar technologies [15]. Researchers in the [16] recognised the blockchain as a promising technology to ensure the privacy & security of the collected data collected by IoT Devices for various applications in healthcare [16].

### III. METHODOLOGY

The proposed framework has the option for storing the complete medical history of the individual along with their parents medical history for the analysis of the diseases for providing the various suggestions to the individual.

The framework is designed to capture information related to the individual to study and analyse the medical conditions of the individual a few among them are following:

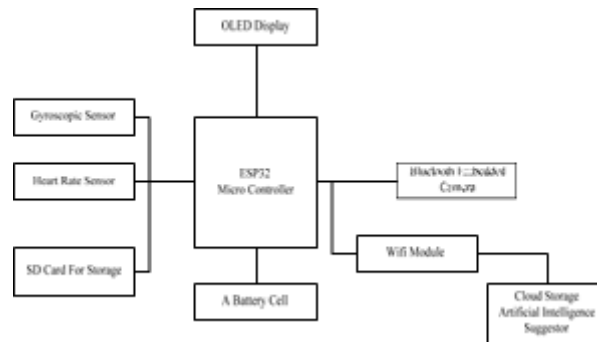
- 1) **Age:** the date of birth of the individual is to be captured for providing the suggestions based on the age of the individual.
- 2) **Geographical Area of Residence:** the geographical area of the residence preferably with longitude and latitude is also stored for the suggestions based on the climatic situations of that place.
- 3) **Medical History of Parents:** The medical history of the parents is also stored for controlling any diseases having influence over the genetic flow from parents to their children.
- 4) **Height:** The height of the individual is also stored for providing some suggestions based on the height of the individual.
- 5) **Weight:** The weight of the individual is also stored for providing the suggestions like Body Mass Index as per age, gender, and height of the individual.
- 6) **Gender:** The gender of the individual for providing various suggestions.
- 7) **Vaccination Details:** The vaccinations details since birth is also stored for the suggestions.
- 8) **Disease History (if any):** Any injury, diseases or any medical related complications are also stored for analysing the individual for providing the suggestions based on the medical background of the individual.
- 9) **Nature of Work:** The nature of the work is stored for studying the effects of the daily work over the body of the individual.
- 10) **Allergy over Body:** Any specific allergy related to the climate, body, work conditions if any known to the individual for better understanding about the individual.

#### A. Parts of the Framework

- 1) **Smart watch or fitness band to be worn in hand:** This device will record heart rate, efficiency of activities done and steps of the user and send it to the server.
- 2) **Camera in locket for neck:** This device will capture all the food intake and send it further to recognize the type of food consumed.
- 3) **WiFi Device/ Internet connectivity:** This will be used to communicate the information to/from the server.
- 4) **A cloud storage for Suggestions:** This will store all information of the user, recognize the food consumed by the user and analyse patterns in activities performed by the user and food intake and advise what is good for user.

## B. Components of the Framework

The following are the components of the proposed framework which integrates with each other with the microcontroller. The idea is taken from the [17] where the various sensors communicate with the microcontroller. The missed call messaging system functionality can also be explored for the future enhancement in the current framework.



**Fig. 1** An efficient artificial Intelligence based framework for monitoring and suggesting food consumption as well as physical exercise to human body (A physical and medical fitness advisor)

- 1) **Microcontroller (ESP32):** This is the component which will communicate the information to/from the server. It will coordinate and control all the devices attached with this.
- 2) **OLED Display:** This is the screen which will be used to display all information to the user. This screen will display all the logs or events occurred over the device.
- 3) **A Rechargeable battery 3.7V:** This is the battery which will be used to power the locket and smart watch or fitness band, it is rechargeable battery for durable solution.
- 4) **Bluetooth enabled Camera:** This is the camera used to capture the food intake of the user. It will communicate with the Bluetooth technology to the microcontroller.
- 5) **Gyroscopic Sensor:** This is the sensor which will be used to count the steps taken by user and find the amount of calories burnt while performing various activities. Heart Rate Sensor This is the sensor which will be used to measure the heart rate of the user.
- 6) **SD Card For Storage:** This will be used to store fitness information of the user.

## C. Working Model

- Camera fitted in the locket hanged in the neck will detect the food intake taken by the human being who is wearing this device.
- The time of consumption and category of the food will be stored in the device with good or adverse quality of the food.
- The fitness band will capture the steps through the gyroscopic sensor. The Heart Rate will also be monitored by Heart rate module fitted in the fitness band or watch. The burnt calories along with the time and type of exercise will be stored in the framework.
- Based on the food intake and the burning of the calories, the suggestions for the food intake will be advised to the human being. If the calories are burnt more and the intake of energy food is less then it will advise for energetic food, and if the intake is more and the calories burnt is less, then it will suggest for the least calories food.
- If the calories burnt is less, then it will advise the exercise for the food physical fitness.
- The framework is also interacted with the cloud storage. Based upon the consumption and exercise history the artificial intelligence will provide the best suggestions form the cloud storage through wi-fi/Internet services by consuming the API (Application programing interface).

#### IV. DISCUSSION AND FINDINGS

The above figure depicts the obesity cases studied during the year 2012-2013 data set extracted from the open internet from the data.world website. ( Obesity in California, 2012 and 2013) sources ”https://data.world/chhs/98672625-8a4e-4100-90ef- 866b4fbf26f7” [ ]schaefer2015peer. The figure above depicts the summary statistics on variety of non-communicable diseases and conditions in BC Data extracted from open internet source ”http://www.bccdc.ca/health-professionals/data-reports/chronic- disease-dashboard”.

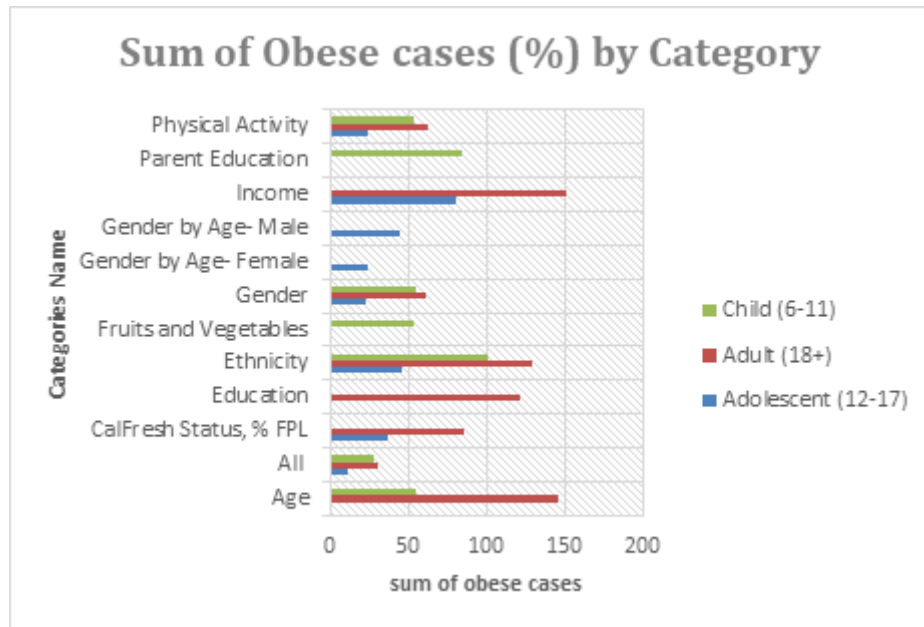
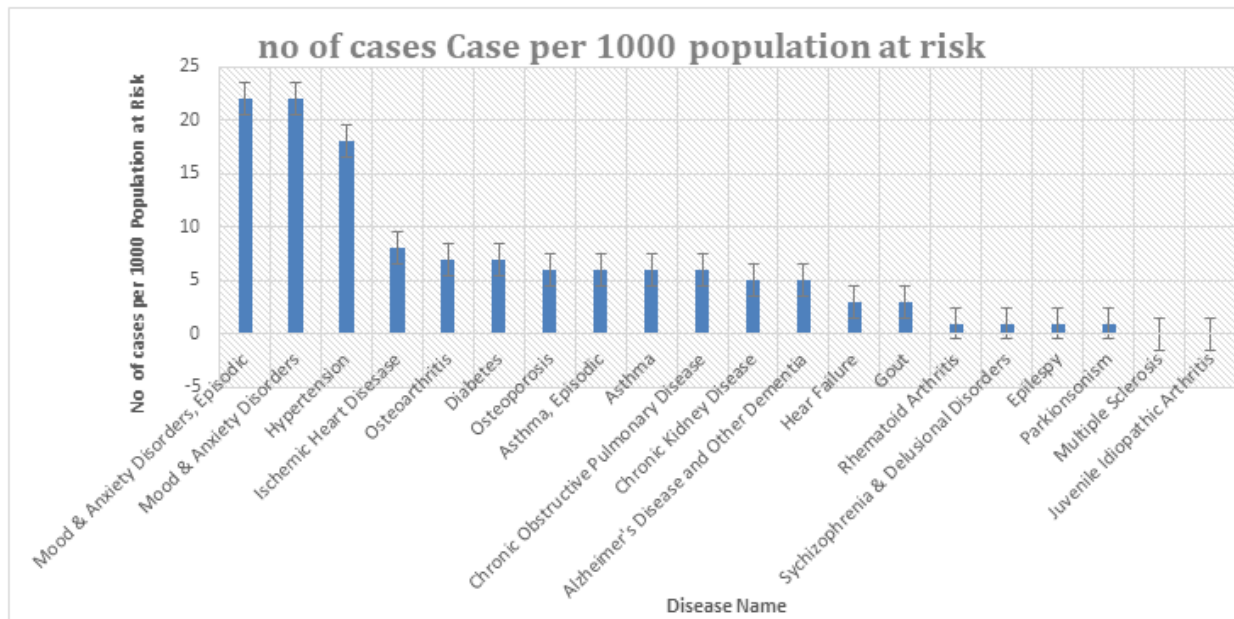


Fig. 2 Sum of obese % by category

#### V. CONCLUSIONS

The various non-communicable chronic diseases were studied and analysed with respect to the various groups, the obesity is the disease can be cured with the help of change in the lifestyle and the diet controlling. The detailed group wise, type wise analysis carried out on the data extracted from the open internet. The exercises and yogas can cure the disease up to the maximum extent, the proposed framework analysed the scenario and proposed the IoT devices to monitor the intake and the exercises carried out by the individual under monitoring through this framework. The suggestions are also advised to the individual through the interactive dashboard. The framework is designed on the open source hardware, the Arduino board, controlling the various sensors and sending the data to the central storage on the cloud where the deep analysis is carried out and the suggestions are generated through the python based programs after analysis. The framework analyses the behaviour of the individual and helping to change the life style based on the input. In future, the framework may be embedded with the block chain technology for ensuring the security I the IoT devices utilized for the collection of various information and stored at the cloud storage. Deep learning and big data analytics may be explored for further scope in the current proposed framework.



**Fig. 3** Different categories of disease of population

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