Stress-Log: An IoT-based Smart System to Monitor Stress-Eating

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Outline of the Talk

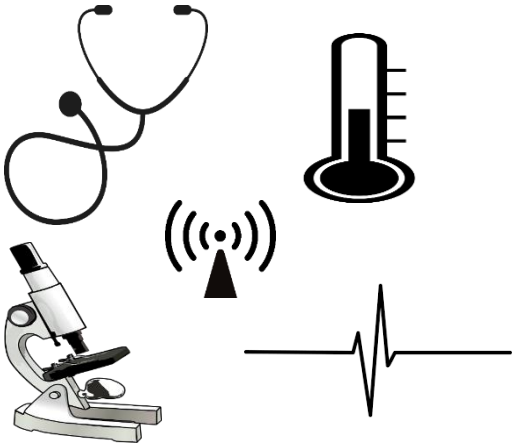
- Introduction
- Motivation
- Proposed Solution
- Novel Contributions
- Broad Perspective Of Stress-Log System
- Proposed Approaches of Stress-Log
- Implementation And Validation Of Stress-Log
- Conclusions and Future Research

Introduction

✓Internet of Things

- The Internet of Things is a network of devices where each device in the network is recognizable and connected.

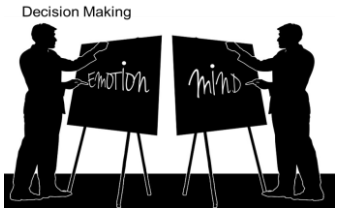
✓Internet of Medical Things

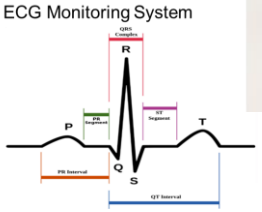


- The Internet of Medical Things is a network of medical devices where each device in the network is recognizable and connected.

Introduction

✓Applications of IoT and IoMT





Research Motivation

✓Why is Stress an important factor to consider?

When there is an encounter with sudden **stress**, your brain floods your **body** with chemicals and hormones such as adrenaline and cortisol.

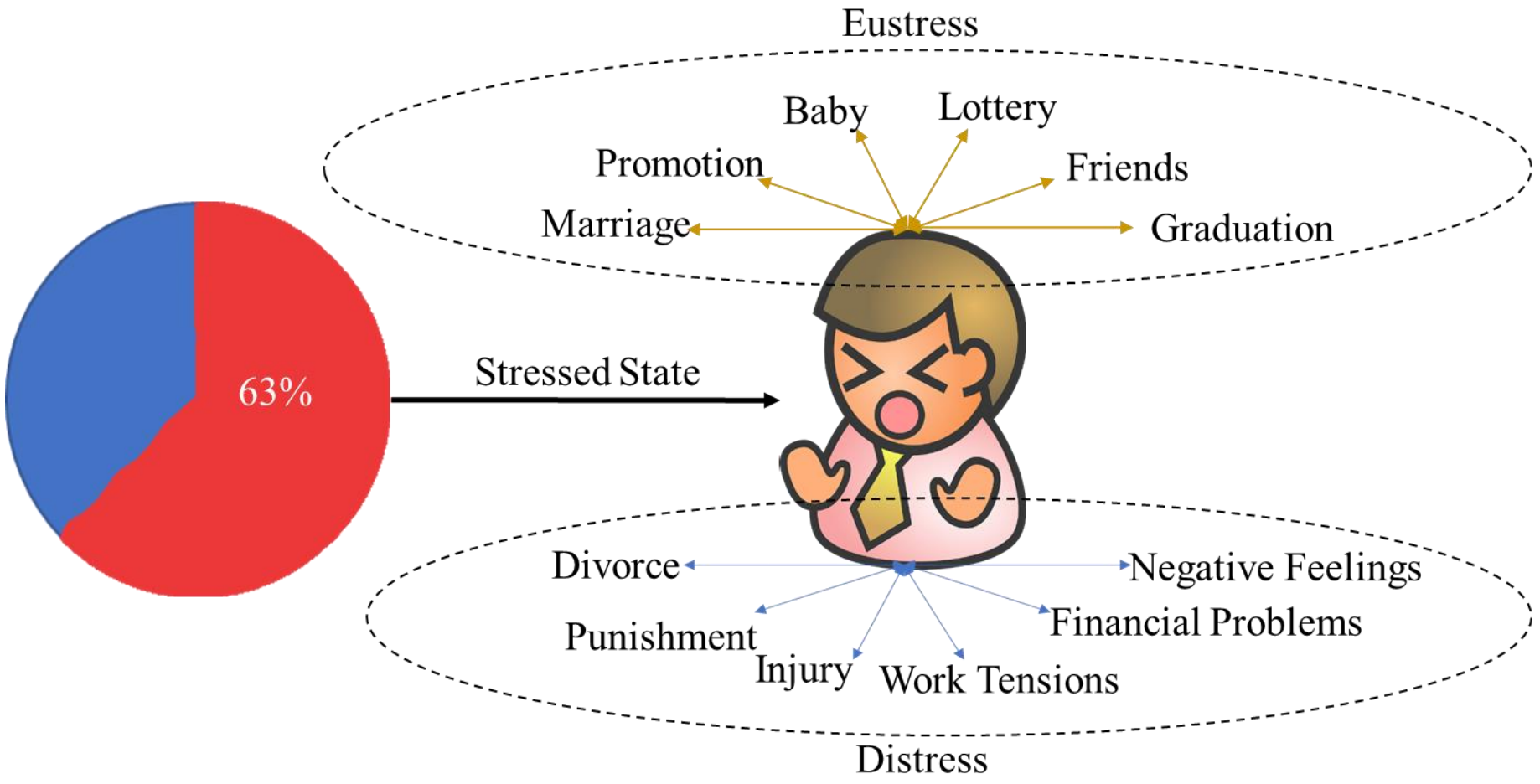
Distress

- ❖ Lack of Energy
- ❖ Over Eating
- ❖ Type 2 Diabetes
- ❖ Osteoporosis
- ❖ Mental cloudiness (brain fog) and memory problems
- ❖ A weakened immune system, leading to more vulnerable to infections

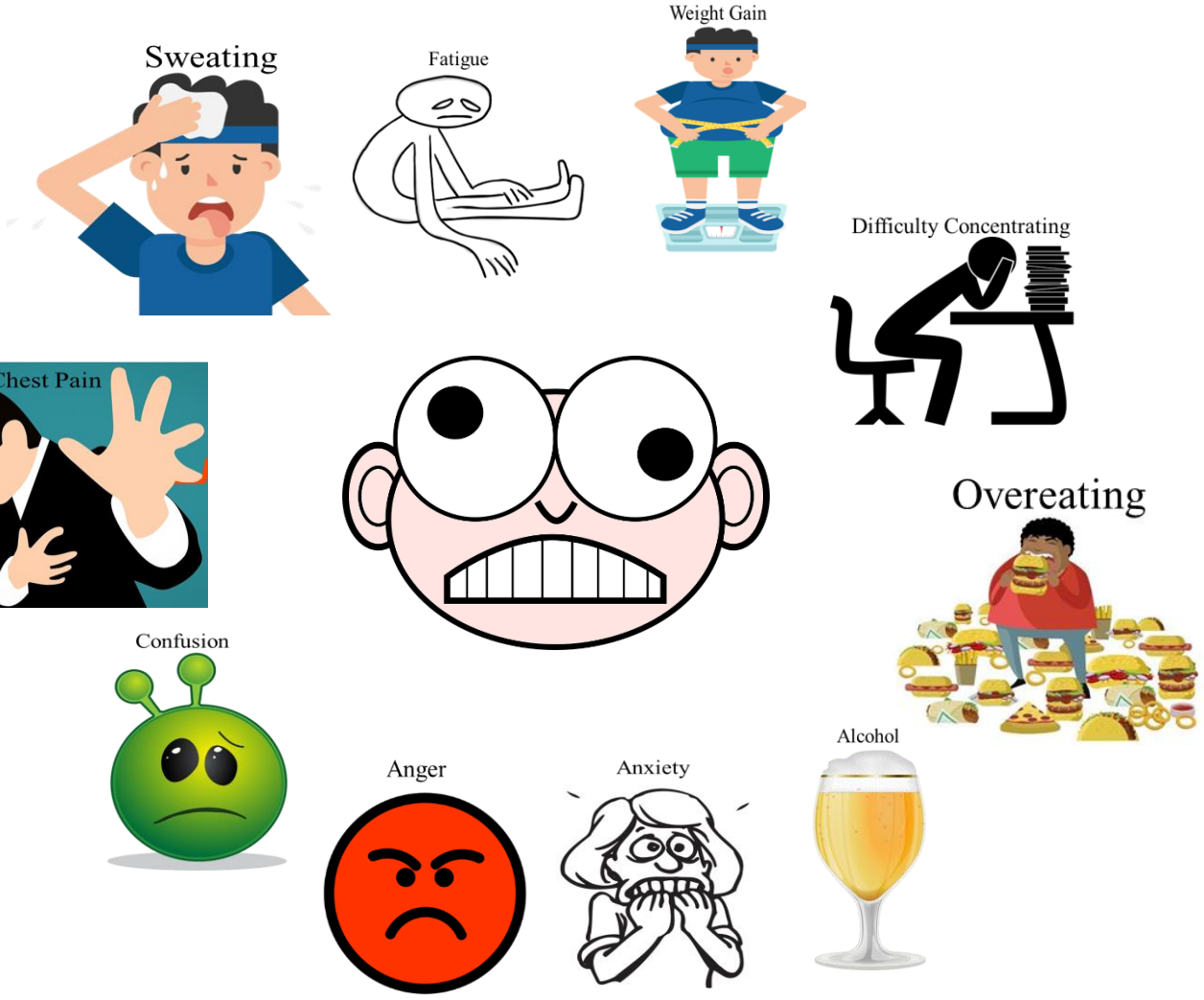
Eustress

Stress is the body's reaction to any change that requires an adjustment or response.

Stressors of Stress



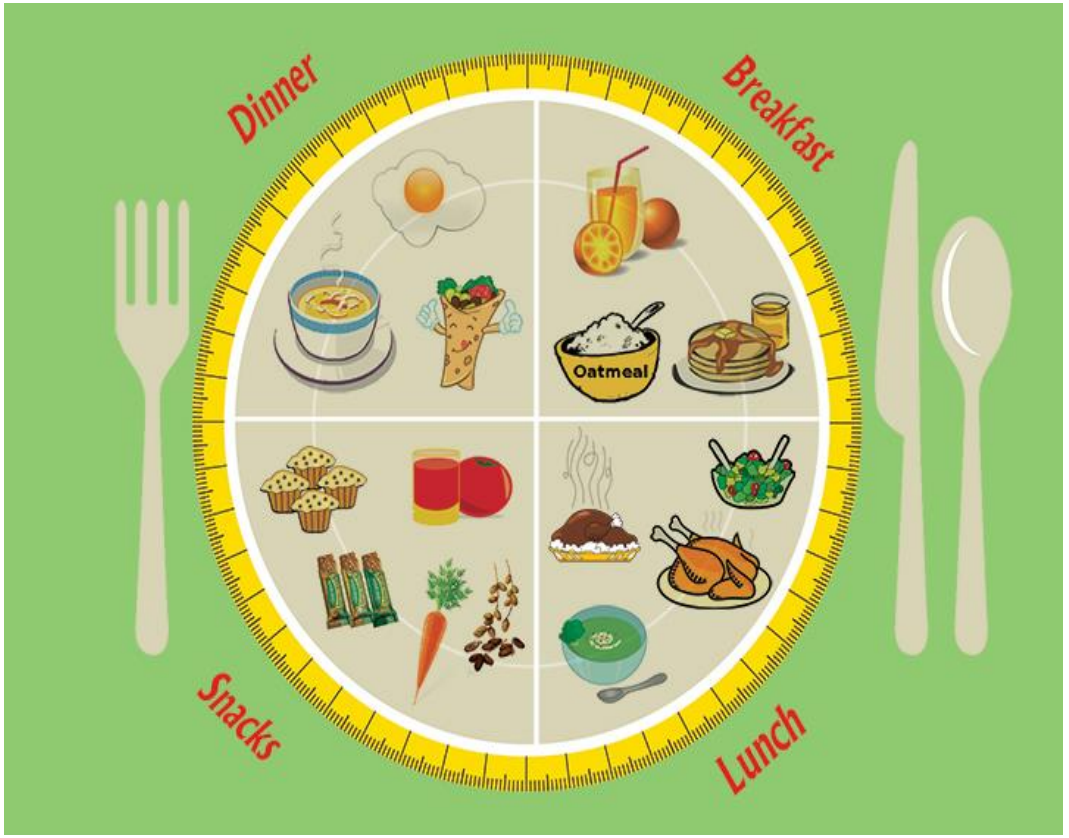
Symptoms of Stress



Stress-Eating?

Chronic stress releases a hormone called cortisol which increases the appetite of a person.

How to Monitor Stress-Eating?



Existing Applications

YAZIO

MyNetDiary

myfitnesspal

MyPlate Calorie Tracker

My Diet Coach

Lose It!

Fooducate

fatsecret

Related Research

Work	Approach	Healthcare Problem	Drawback
Chang, et al. [18]	Pressure Method	Food Intake Monitoring	Food classification and weight estimation is not possible
Cadavid, et al. [19]	Surveillance-Video Method	Food Intake Detection	Needs external camera and a steady place while eating food
Tanigawa, et al. [20]	Doppler Sensor Method	Food Intake Monitoring	Non-wearable approach

Issues of Existing Solutions

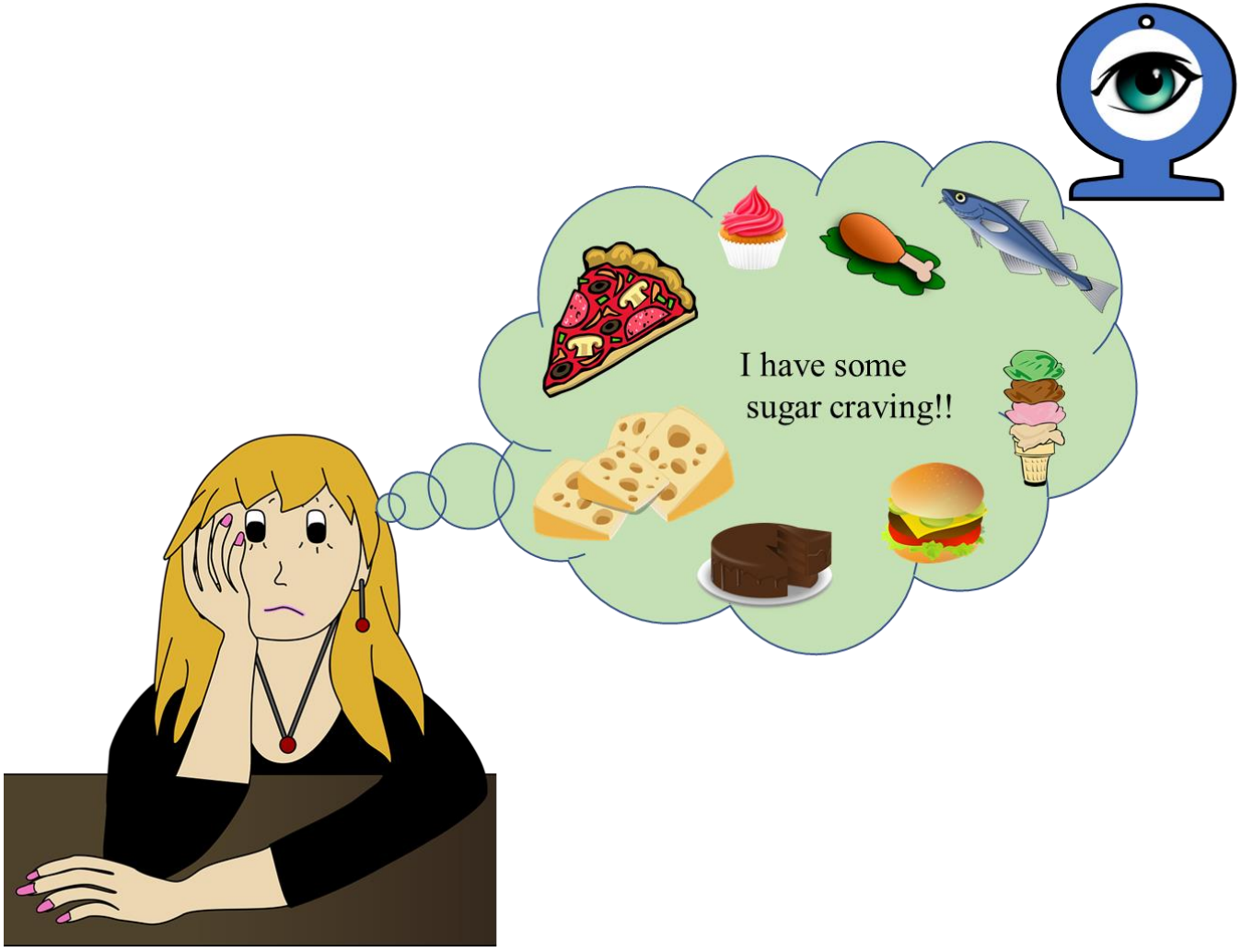
- Continuous Analysis of Food Monitoring is not provided.
- Manual Input of food consumed is a must.
- No Unified detection of the problem.
- Fully utilization of technology which can be a part of the product.
- Storage availability of the detected parameters for future usage.
- Self-Aware systems.

The Research Question Addressed in this Paper

- How to have a rapid continuous stress-eating detection system that educates the user without disturbing the comfort and analyses the data at the user end (at *IoT-Edge*) and stores the data at the cloud end (at *IoT-Cloud*)?

Proposed Solution: Stress-Log

✓**Conceptual Overview of the Stress-Log.**



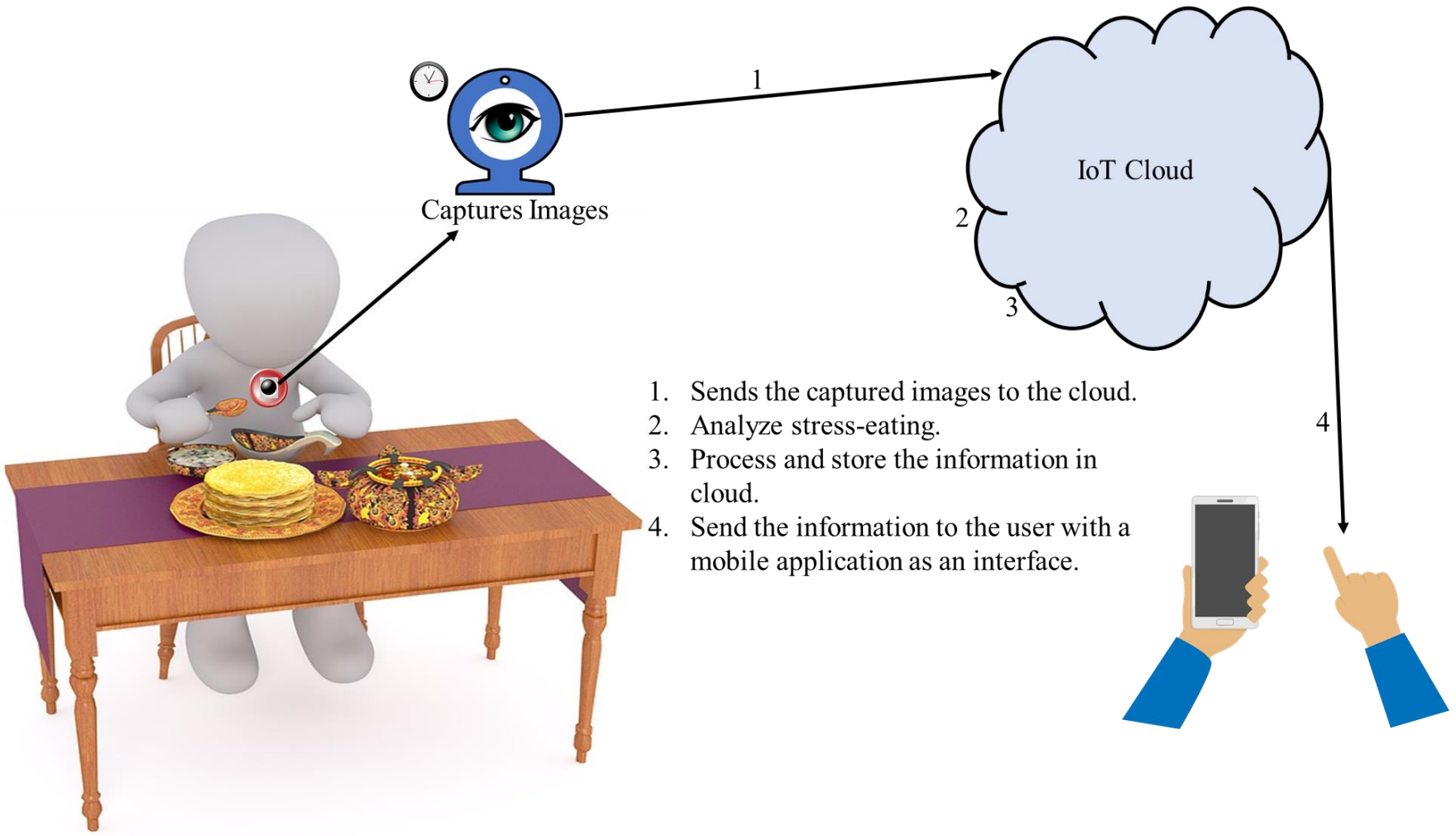
Novel Contributions

- Continuous analysis of stress levels in a person by using a wearable.
- A non-wearable manual input of the foods consumed, and analysis of stress eating is done at the same time.
- If stress eating is detected, techniques to resolve stress are proposed.
- Allowing the user to access his/her own predicted stress levels from previous days' data are provided with access to database storage.
- A mobile application is built which acts as an interface indicating the total number of calories consumed by the person along with the awareness of stress-eating and normal eating.

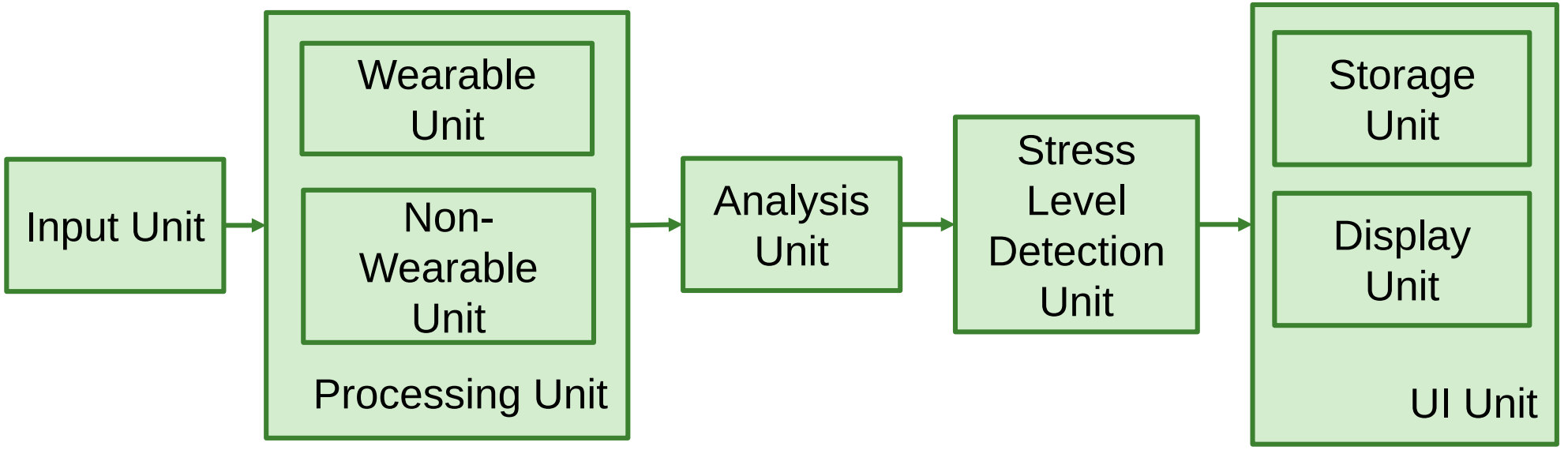
Issues Addressed in this Research

- Advancement through this paper in Electronics.
- Significant Improvement in the comfort of the user.
- Considered Non-Wearable for the detection.
- Provided cloud storage access for future purposes.
- Proposed a self-aware system which is intelligent enough to detect the stress-eating behavior.
- An edge level system is presented with which the performance, accuracy and stabilization of
  the system can be maintained.

Proposed Novel Architecture



Block Diagram Representation



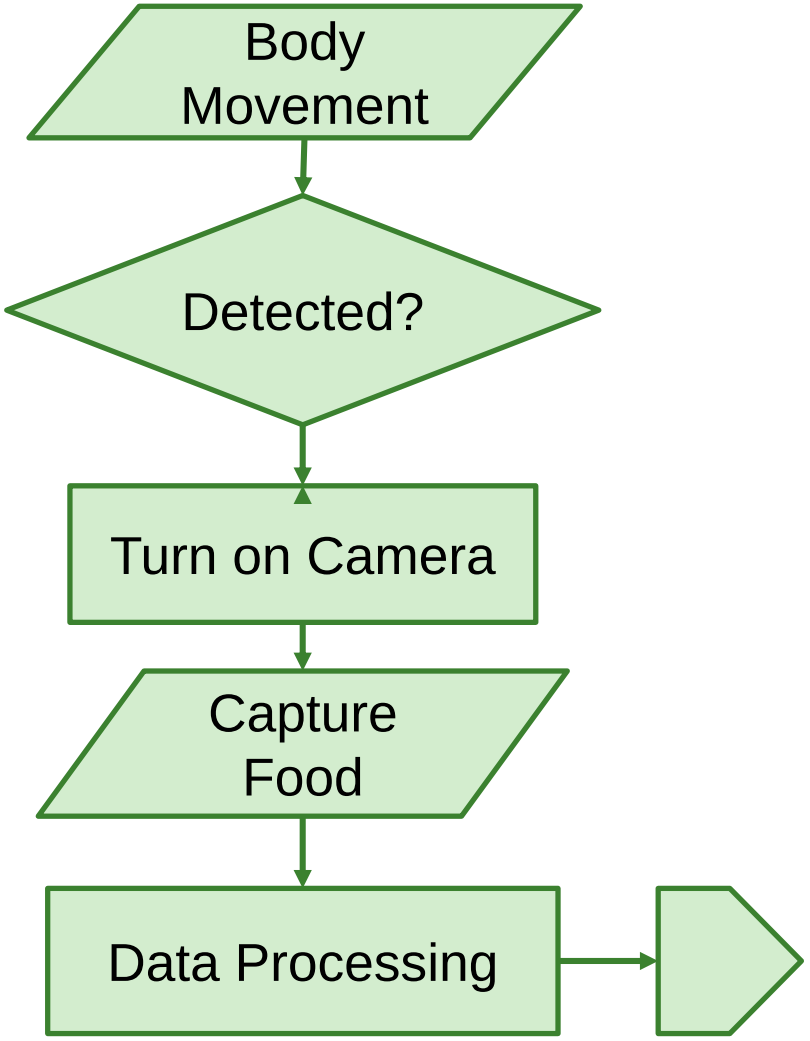
Factors Considered

✓ Data Collection.

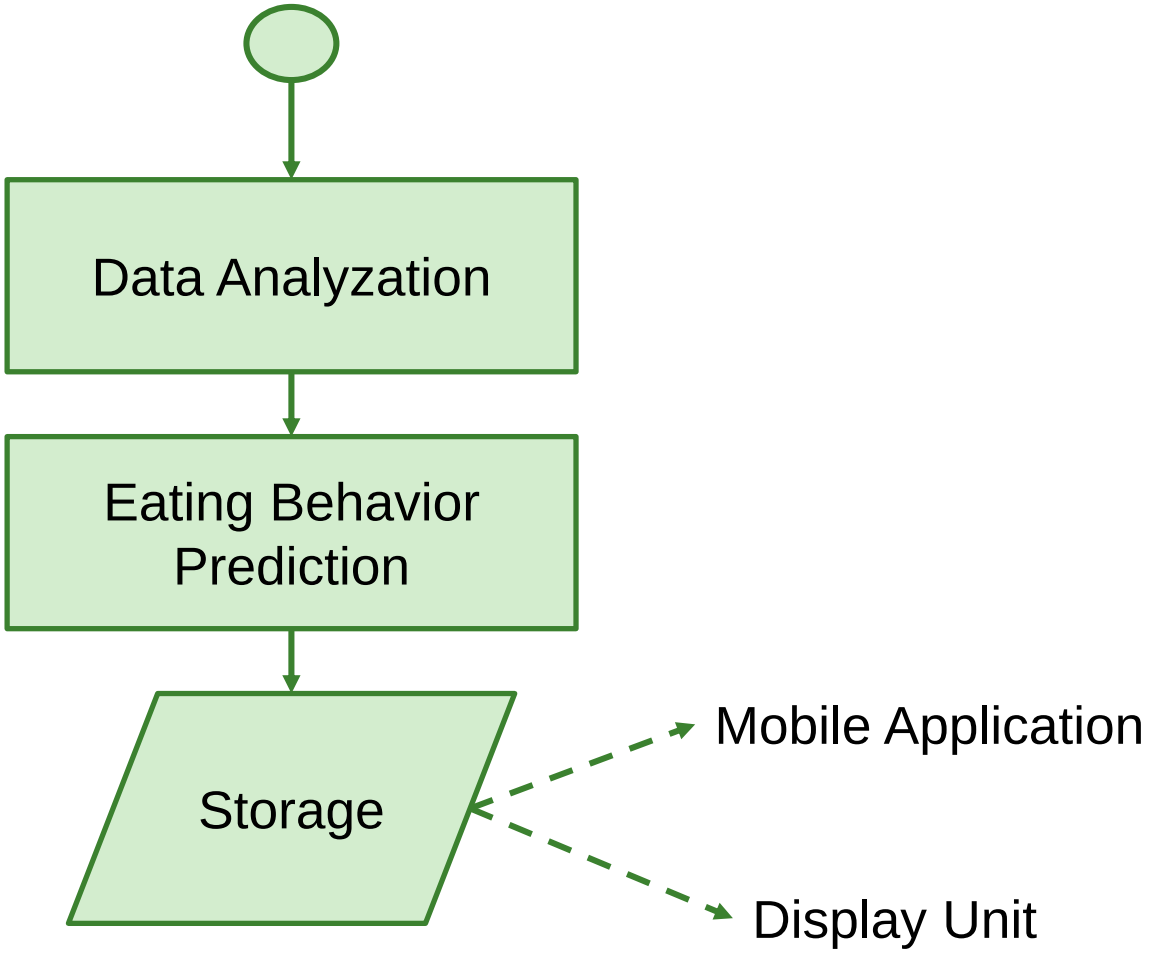
In order to analyze the eating behavior of the person, the following data are considered:

- The type and amount food consumed.
- The time at which the food is consumed.
- The gender of the person.
- The mood of the person after every meal.

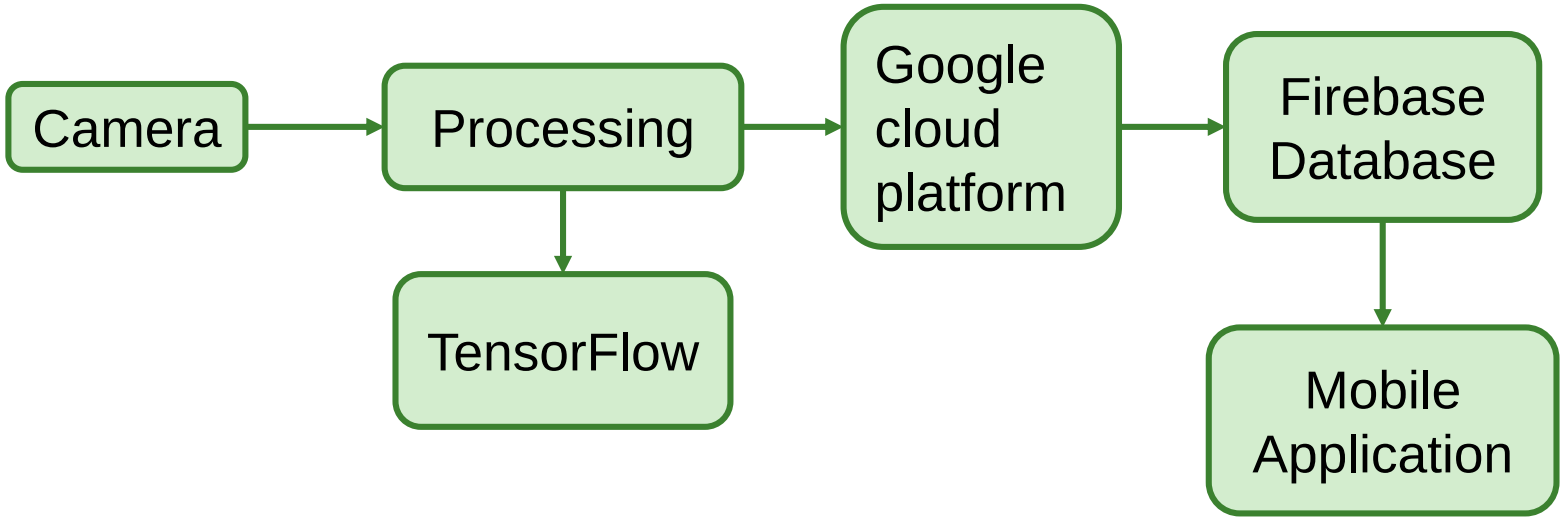
Flow of Stress-Log



Flow of Stress-Log



Wearable Approach



Wearable Approach

✓ Processing

❖ Tensorflow Object Detection API

- Creating accurate machine learning models capable of localizing and identifying multiple objects in a single image remains a core challenge in computer vision.

- The TensorFlow Object Detection API is an open source framework built on top of TensorFlow that makes it easy to construct, train and deploy object detection models.

Wearable Approach

❖ Google Cloud Platform

- ✓ Google Cloud Platform is a suite of public cloud computing services offered by Google. The platform includes a range of hosted services for compute, storage and application development that run on Google hardware.
- ✓ Google Cloud Platform offers services for compute, storage, networking, big data, machine learning and the internet of things (IoT), as well as cloud management, security and developer tools.

❖ Firebase Database

- ✓ The Firebase Realtime Database is a cloud-hosted database. Data is stored as JSON and synchronized in real-time to every connected client. All the clients share one Realtime Database instance and automatically receive updates with the newest data.

Wearable Approach

✓Methodology

- In order to analyze the data from the collected images to detect stress-eating behavior, the machine learning based smart system TensorFlow is used.
- We collected 1,000 images from the open access repository Pixabay by searching for images with food-specific keywords such as doughnuts, vegetables, noodles, rice, etc.
- The images are labeled manually using the TensorFlow application labelimg.exe, to mark the image regions with specific food items.

Wearable Approach

✓Methodology

- Overall, there were 130 varieties of food labeled in the images.
- Of these images, 800 were used for training and 200 were used for testing.
- We have used TensorFlow version 1.9.0 and have utilized the object detection application programming interface.
- The dataset which is used for training and testing is an opensource Food-a-pedia dataset with 2015 varieties of food along with their calorie count per serving, sugars and fats.

Non-Wearable Approach

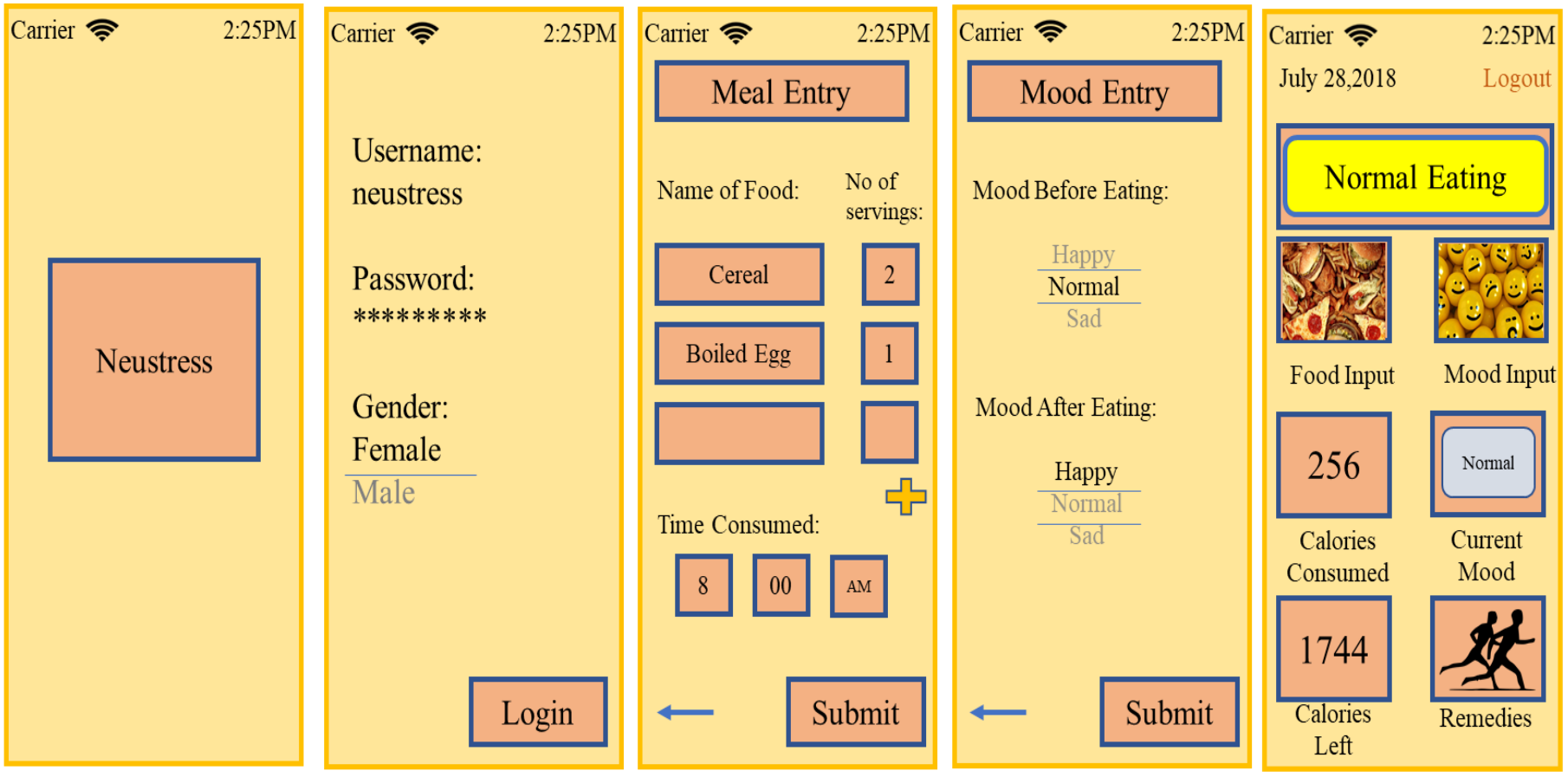
- The application was developed by using the Xcode 8.3 development platform and used the Swift 3.0 programming language.

Analyses of Stress-Eating

Recommended Calories/day	Sugars (gm/day)	Total calories	Time interval (hours)	Mood	Stress-Eating
Men: 2330	37.5gms of sugar or 150 calories	2500	6	Happy	Stress-Eating
Women: 1830	37.5gms of sugar or 150 calories	2000	5	Happy	Stress-Eating

Implementation- Normal Eating

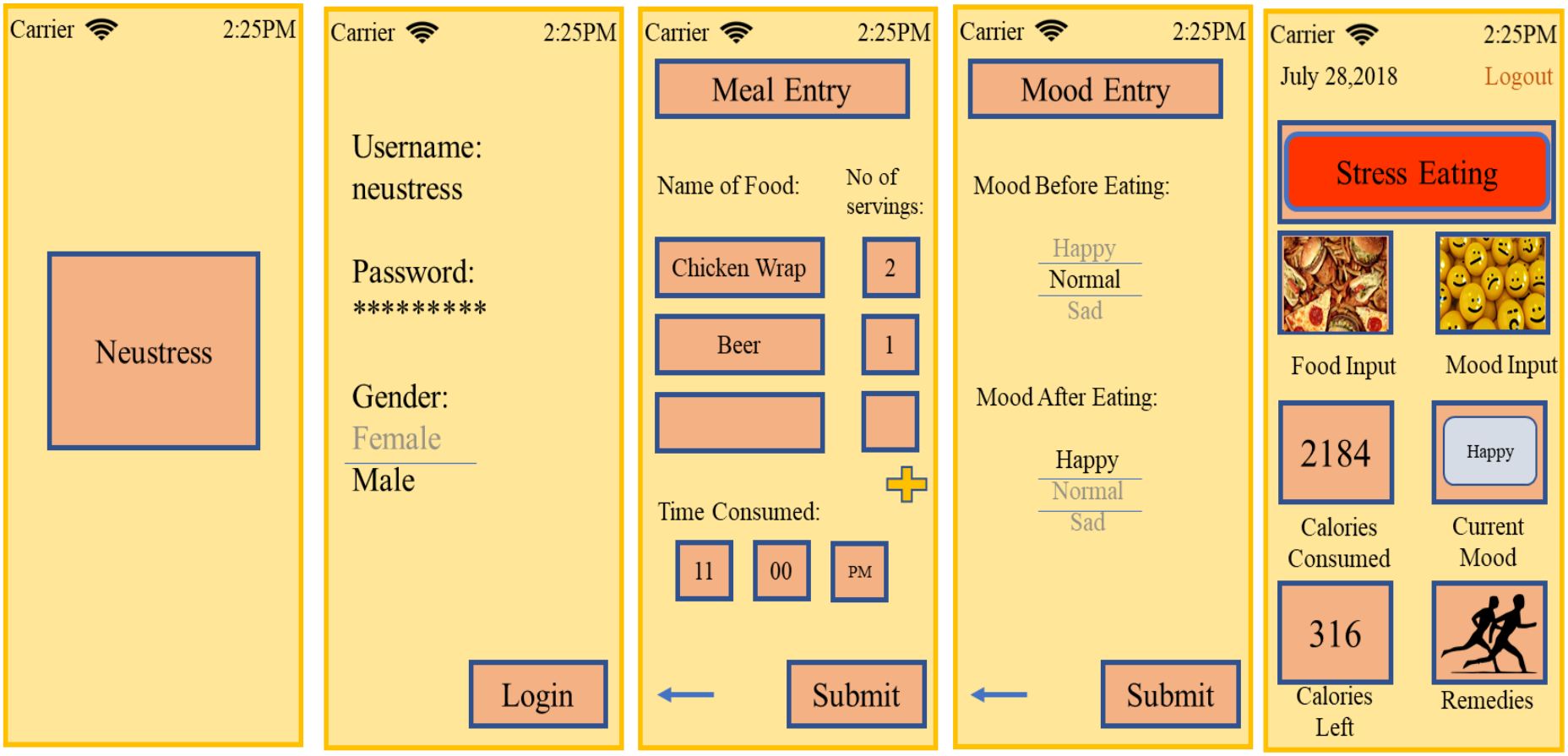
✓ Non-Wearable Approach



Non-wearable Normal Eating Result

Implementation: Stress-Eating

✓ Non-Wearable Approach



Non-wearable Stress Eating Result

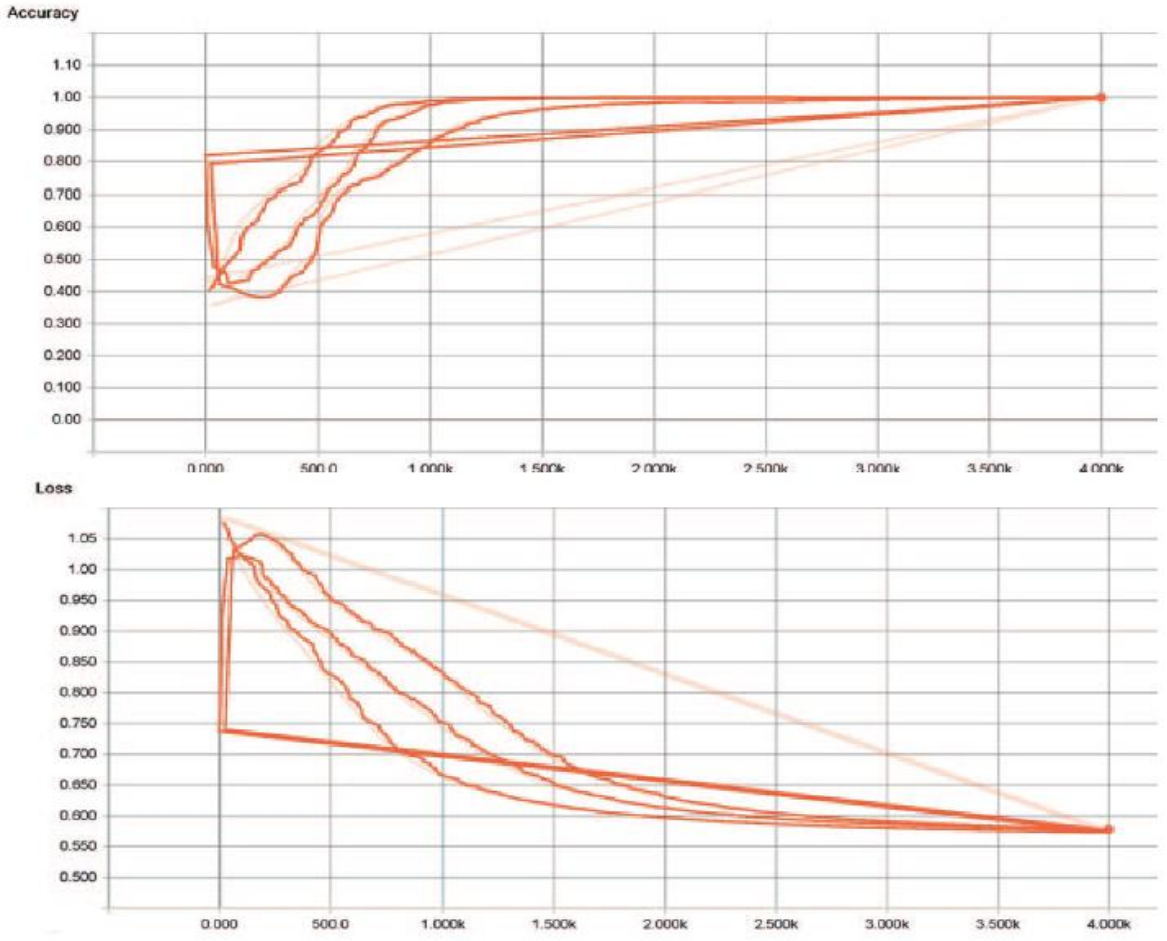
Implementation: Wearable

✓ Wearable Approach

The data collected is sent to the Firebase Database in which the calorie count is generated by using a dataset with calories and sugars count of individual items from data.gov.

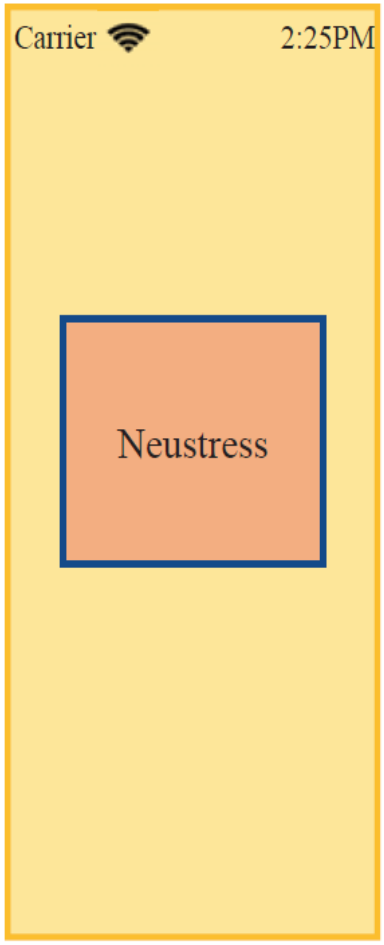
Implementation: Loss & Accuracy

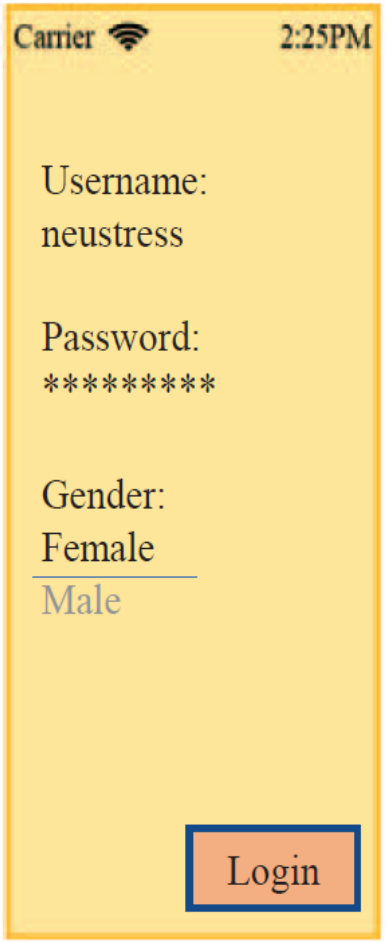
- ✓ **Loss and Accuracy of Object Detection**

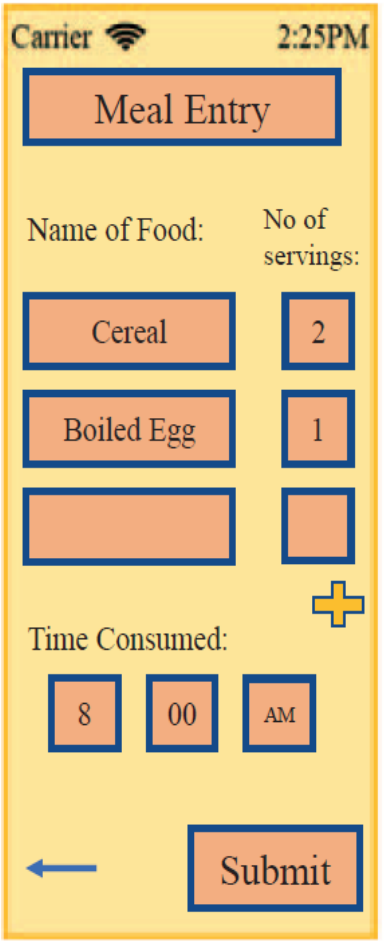


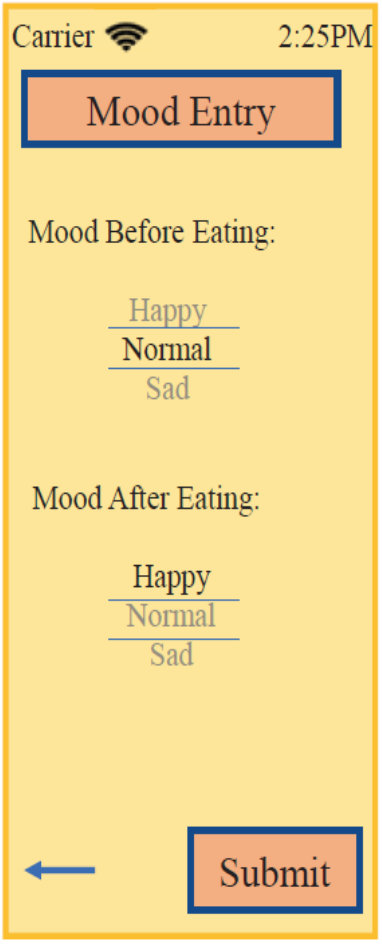
Implementation- Normal Eating

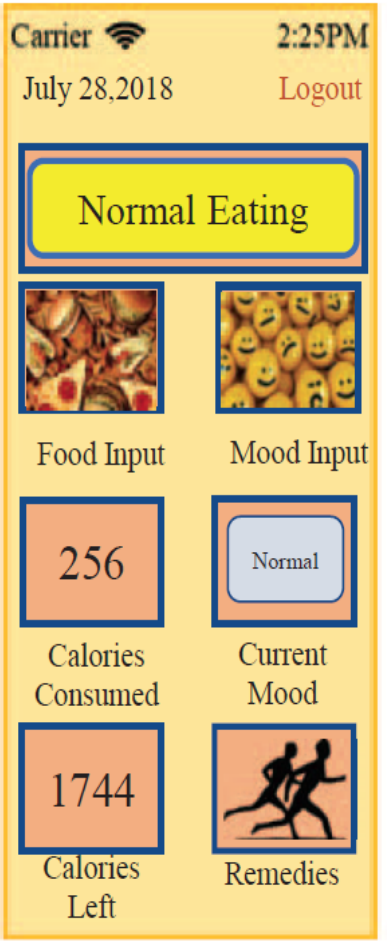
✓ Wearable Approach











Wearable Vs Non-Wearable

✓ Brief of the Proposed Approaches

Wearable Approach	Non-Wearable Approach
Expensive when compared to the non-wearable approach as it doesn't deal with much hardware.	Cheaper when compared to the wearable approach.
User should feel comfortable to have the hardware on them.	User will not face any discomfort as it is the mobile application.
Smart, Intelligent system which helps in producing results with better accuracy.	Manual input systems where the accuracy will be questionable.
Establishes the relationship between the food consumed and the stress levels of the person with minimum manual input.	Establishes the relationship between food consumed and stress with only manual inputs.

Comparison with Existing Research

Research	Stressors	Device Prototype	Self-analysis	Cost
Vanstrien, et.al [38]	Sad and Joy news	No	Not possible	Moderately High
Vanstrien, et.al [39]	Statistics and Meditation	No	Not possible	Moderately High
Adam, et.al [40]	Challenge and Fear conditions	No	Not possible	Moderately High
Harrison, et.al [41]	Pictorial stroop task, emotion recognition in images	No	Not possible	Moderately High
Ariga, et.al [42]	Structured interviews, self-rate questionnaire, statistical analysis	No	Not possible	Moderately High
Stress-Log (Current Paper)	Daily activity, human time isn't required	Yes, a mobile phone application and a wearable for instance a camera are presented	No need of heavy equipment; self monitoring is allowed	Moderately low

Conclusion and Future Research

- The approach presented here provides an extension to the monitoring systems by focusing on the eating behaviors of the users and analyzing if the eating is stressed eating or normal eating.
- The accuracy of detecting food composition is found to be 97%, which strongly suggests this approach is suitable for effectively logging nutritional and calorific value of daily food intake.
- The approach could be an answer to a long-time sought-after need for watching the food behaviors and their impact on overall physical and mental health.

Thank You !!!