

Intelligent Food Intake Monitoring System

By: Aswin Natesh (111582677)

Aishwarya Gandhi (111424452)

Agenda

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❑ System Design

- ❑ Sensing Module

- ❑ Hardware Module

- ❑ Web Application

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❑ Project Conclusion

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Introduction

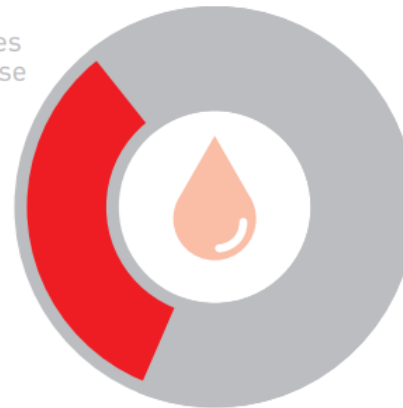
DIABETES IS
ON THE RISE



422 MILLION
adults have diabetes

3.7 MILLION
deaths due to diabetes
and high blood glucose

1.5 MILLION
deaths caused
by diabetes



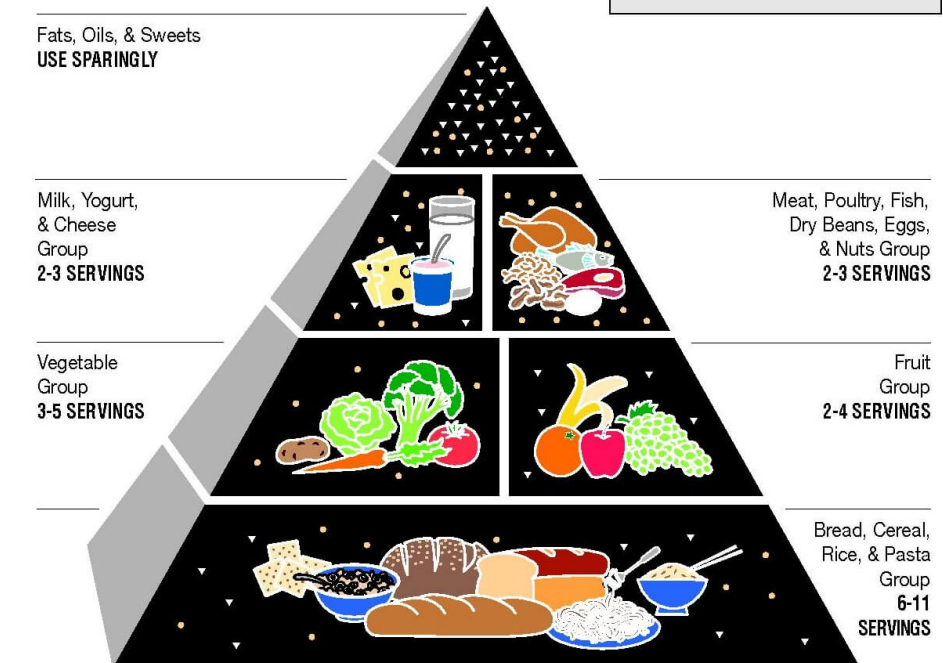
THAT'S 1 PERSON IN 11



Source: Based on information from the International Diabetes Federation

The Food Guide Pyramid

A Guide to Daily Food Choices



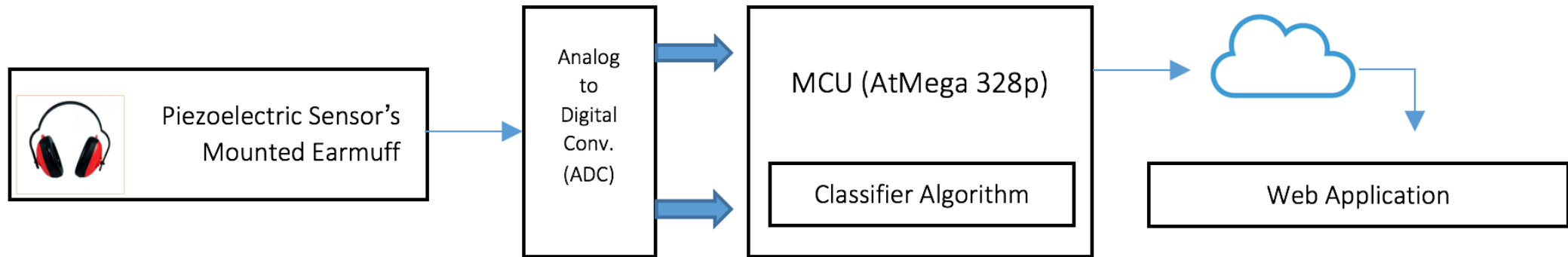
Existing Solutions

- They infer eating indirectly from, for example, hand movements or capturing **food images**.
- They are non-pervasive requiring manual data entry or **user involvement** in capturing data.
- They are **non-wearable**, bulky, invasive, or semi-invasive.
- They exhibit **low accuracy** in detecting swallows and distinguishing food types.

Proposed Solution

- Piezoelectric sensor based detection of Chews and Swallow
- A light weight non-intrusive earmuff with sensors affixed
- Detects facial muscle contractions
- Recognizes type of food being consumed in Real – Time (4ms Latency)
- User Friendly Web Application based Feedback Reports (Updates every 5 mins)

System Block Diagram



Sensing Module

- Consists of a pair of **piezoelectric sensor**, also known as a vibration sensor affixed to an earmuff.
- Produce a voltage when subjected to **physical strain** and **contact vibrations**
- Positioned firmly on the user's upper cheeks to capture **muscular contraction**
- Sampled at frequencies at 9 GHz

Hardware Module

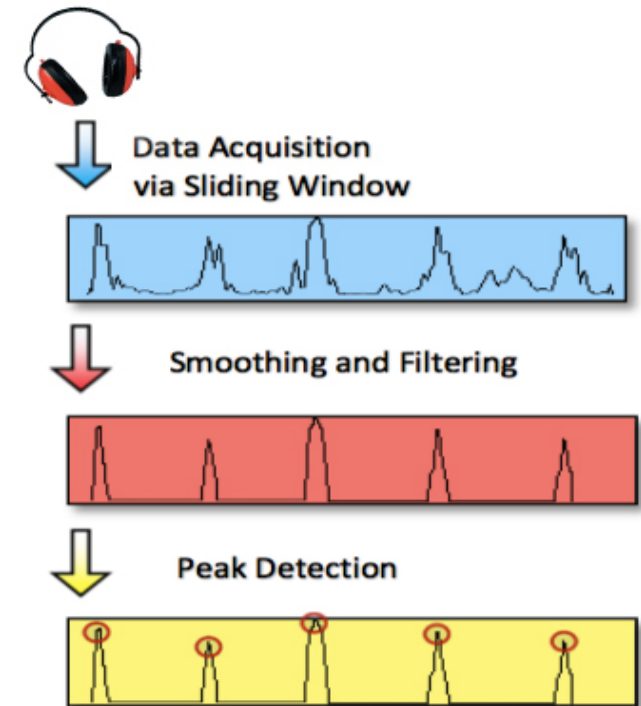
- Consists of **Atmega328** Microcontroller and **ESP8266** (aka Node MCU)
- The sensed data is passed through a **8-bit Analog to Digital Converter**
- Runs a light-weight real-time **classifier algorithm**

Food Type Recognition (Feedback)

- Type of food consumed
- Excessive snacking alert
- Chewing frequency
- Interval of food intake
- Last food intake time

Classifier Algorithm - Stage 1

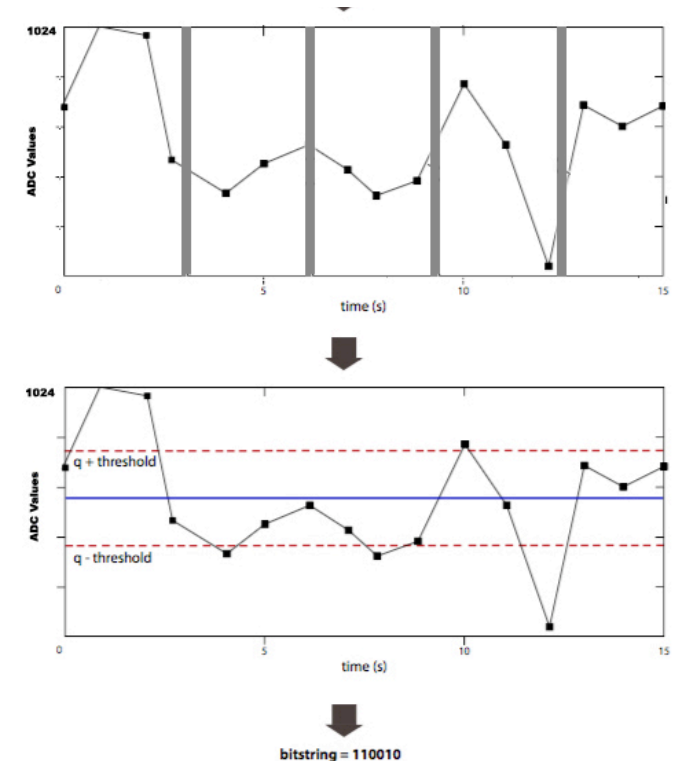
- Peak Detection using Sliding Window
 - The sensed data is **buffered locally** until a sufficient number of samples have been acquired.
 - Smoothened using **convolution filter**
 - **Rising peaks** within windows are detected



Classifier Algorithm - Stage 2

- Level Crossing Quantization
- Number of peaks that crosses each of the threshold $q+$ and $q-$ are detected
- These values are then used for food type and hardness classification

Chewing Rate/Frequency is calculated by finding the difference in time between peaks.



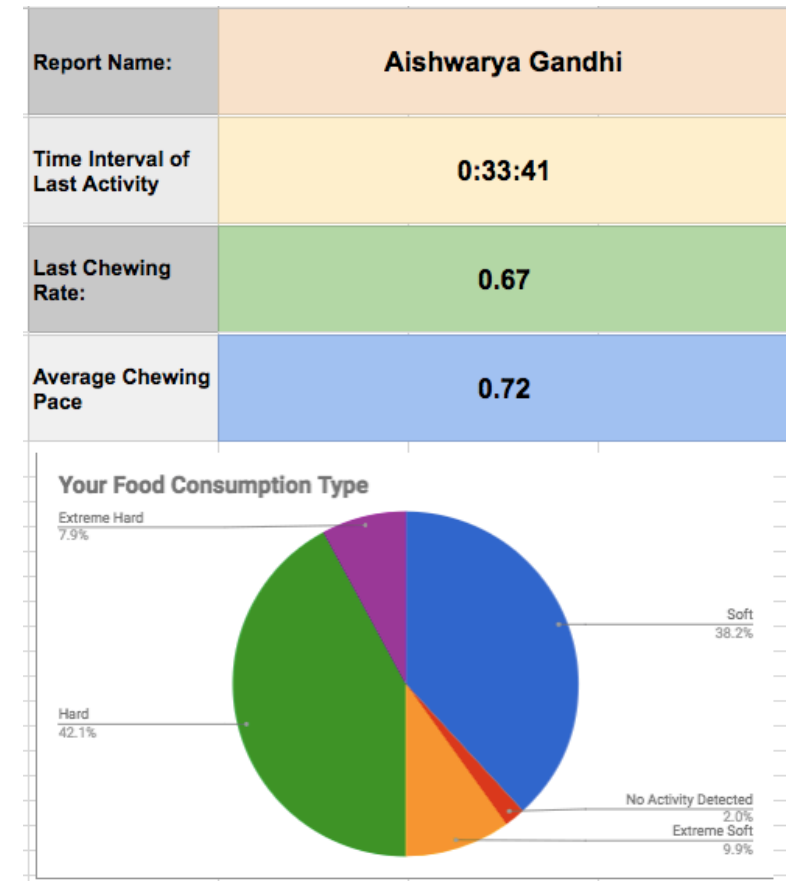
Bit Stream & Food Type Classification

Handshake (MSB)	No Activity	Ext. Soft	Soft	Hard	Ext. Soft (LSB)
B[0]	B[1]	B[2]	B[3]	B[4]	B[5]

Category	Food Subset
Extremely Soft	Yogurt, Pudding and Soup
Soft	Rice, Bread, Corn Flakes, Soft Fruits
Hard	Tortilla, Biscuits and Hard Fruits
Extremely Hard	Potato Chips, Tortilla Chips

Web Application

- Performs two major roles
- Serves as a **Data Manager**
- **Keeps track** of food intake activity and provides **feedback** after analysing data.
- <http://aswinnatesh.com/CPS-Project/>



Experimental Results & Future Scope

- The system was tested and data are collected from 2 different subjects.
- The system was trained over 10 trials to fix quantization parameters.
- We observed that it is challenging to distinguish between solid food types.
- False positives were approximately 4.06%
- Liquid food activity was not attempted in this project as the system was designed to detect solid foods in particular.
- Future work would include classifying solid food from liquid food with no addition of resources



THANK YOU!

Any Questions?