Design and Real-time Implementation of an Intelligent Classroom using IoT, AI and Cloud architecture

Capstone Project by Team-71

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Project Statement

A proposal for an IoT-based intelligent environment, with the primary objective of energy optimization and an intelligent, yet reliable attendance system that focuses on reducing latency to give an enhanced learning experience.

The Problem

What we want to solve

For a long time, attendance has always been taken manually. This has caused multiple discrepancies and has wasted useful class time.

In addition to this, classroom equipment like fans etc. have occasionally been left on thereby wasting considerable energy

The Proposal

How to solve it

A fully edge computed, integrated bio metric based solution for attendance which is modular and carried by the teacher to ensure security

An ambient and spatial sensor based approach to dynamically turn on and off the fans and lights based on the occupants of the room

Objectives

What we want to achieve

- Overhaul the current attendence system to make it more seamless, effortless and less time consuming

- Ensuring the lights and fans turn off automatically when not needed thereby significantly decresing the energy footprint of the classroom

- Equip the teachers with a cloud based dashboard containing analysis on the number of students attending classes and the overall intake and timing on a per subject basis

Literature Survey.

The conventional methods practiced in most of the institutions for attendance are by calling names or signing on papers, which is highly time-consuming and insecure.

There exists a solution which presents the automatic attendance management system for convenience or data reliability.

The system is developed by the integration of ubiquitous components to make a portable device for managing the students' attendance using Face Recognition technology. [1]

It is observed that maximum amount of electricity consumption of any country comes from its education institutions, which is a major setback for its economy.

There has been lot of research carried out using sensors but some drawbacks can be seen in the existing ceiling mounted sensor due to coverage, cost and other factors.

Our attempt is to implement an automatic lighting system, where classroom is divided into grids and PIR sensor placed towards capturing the entrance of human inside class room. [2]

[1],[2]: References are added at the end of the presentation.

Solution 1 : Attendance

- **Attendance can be taken electronically by means of a biometric optical fingerprint scanner**

- **Security and integrety can be ensured by making the biometric module portable and modular - a small phone sized module carried by the teachers**

- **The teacher can pass around/have each of the students scan their prints and register their attendence with no manual intervention**
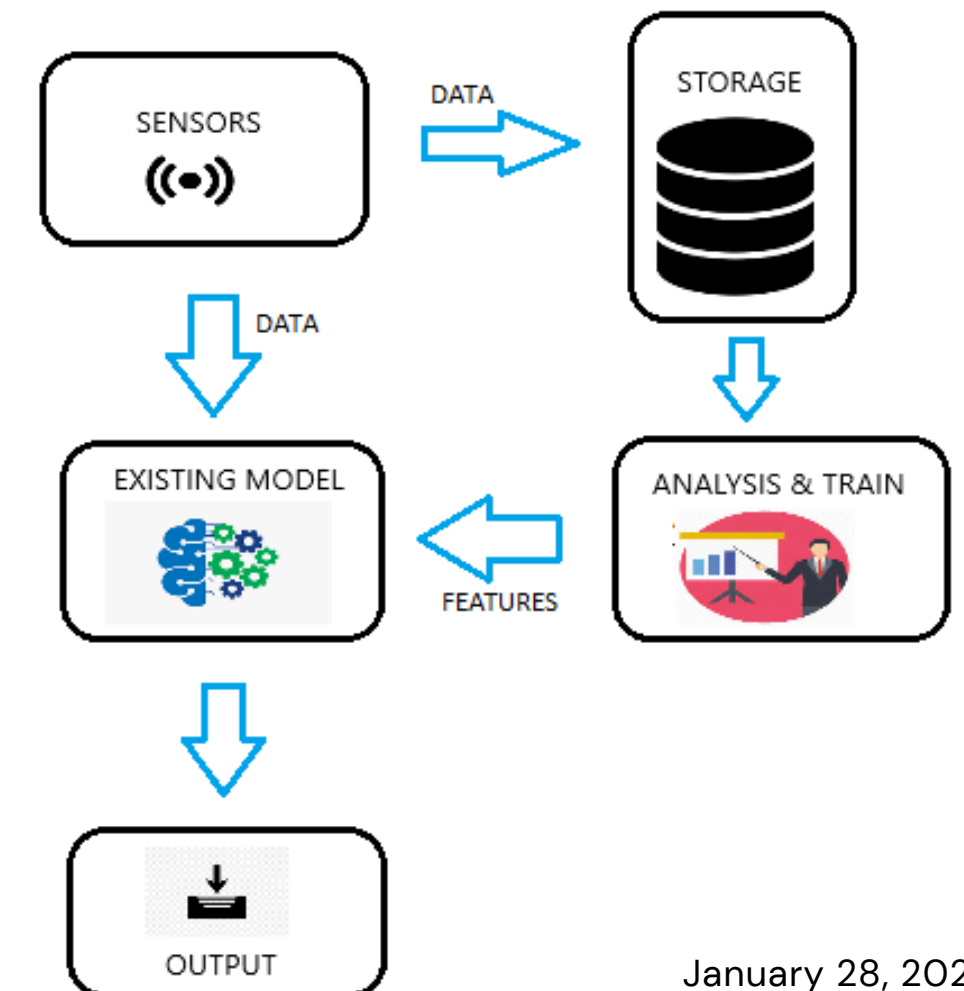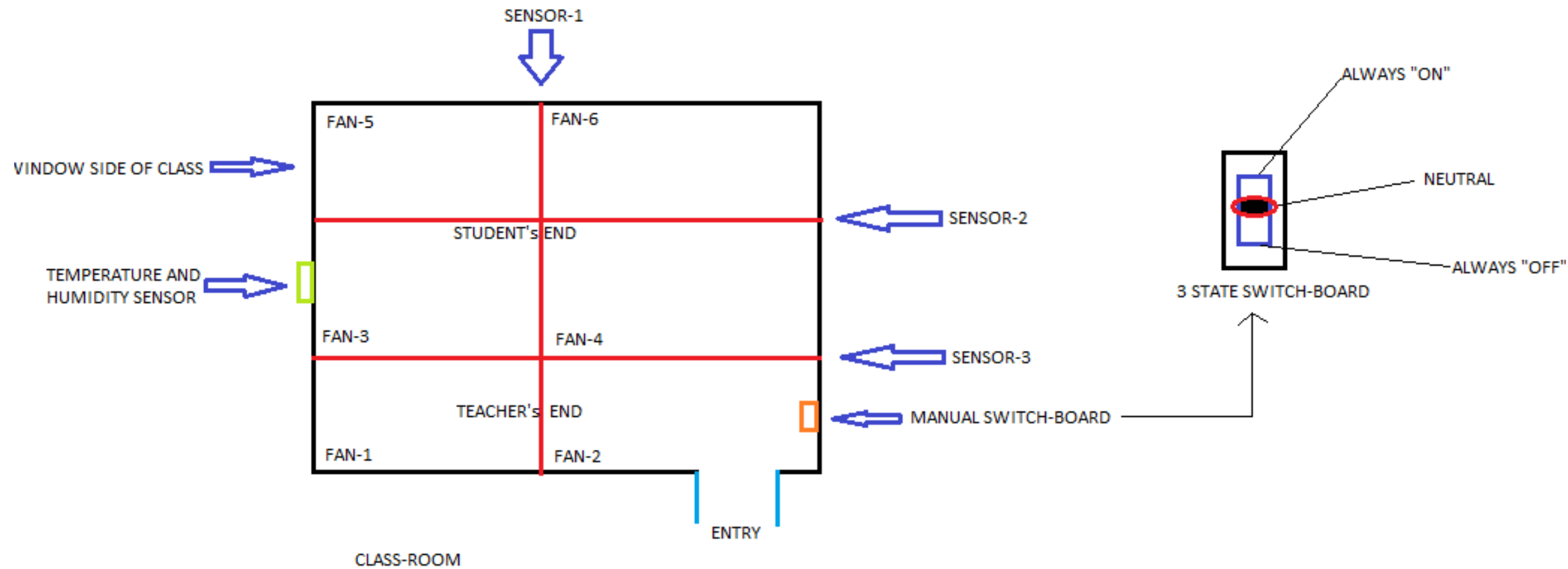
Block Diagram - I
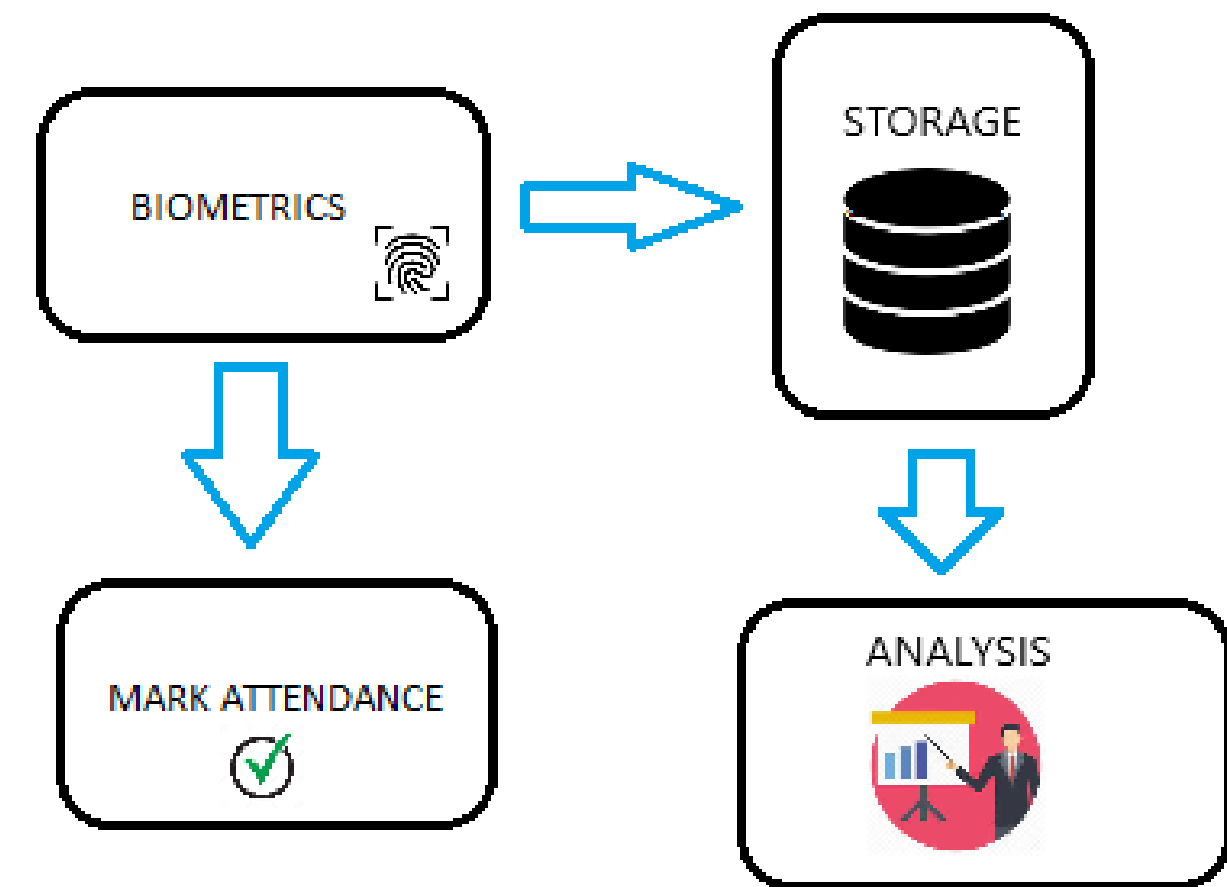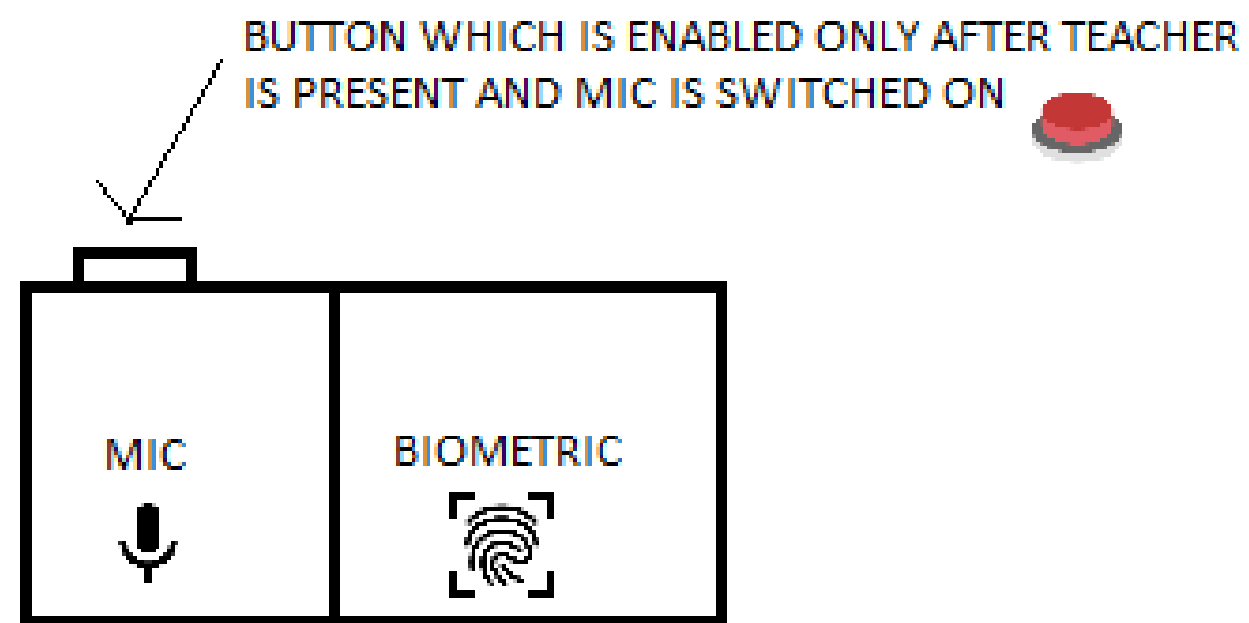
Solution 2 : Electricity Optimisation

- **Spatial sensors placed at the edges of classrooms will notify the system of movement and activity in the room**

- **Edge computed algorithms ensure that the lights and fans are turned on only at specific portions of the room incase of a large classroom/hallway**

- **In case of manual fans, temperature monitors are used to add a level of cost effective automation**

Block Diagram - II

SENSOR-1

FAN-5   FAN-6

VINDOW SIDE OF CLASS

STUDENT's END   SENSOR-2

TEMPERATURE AND
HUMIDITY SENSOR

FAN-3   FAN-4

TEACHER's END   SENSOR-3

FAN-1   FAN-2   MANUAL SWITCH-BOARD

ENTRY

CLASS-ROOM

ALWAYS "ON"

NEUTRAL

ALWAYS "OFF"

3 STATE SWITCH-BOARD

SENSORS   DATA   STORAGE

DATA

EXISTING MODEL   FEATURES   ANALYSIS & TRAIN

OUTPUT

Technology

- Optical Biometric Sensor module to record individual fingerprints
- Spatial sensors to check which part of the room is occupied to make the system spatial aware
- Arduino Uno/Any equivalent microcontroller to manage per classroom function at the edge of the network
- WPF/UWP to make the dashboard application for administrator management

Advantages

- Overhaul of attendence will save considerable amount of time and make the work of the teachers easy
- Modular sensor overlooked and handled by the teacher will ensure security and integrety and will make the system fullproof
- Fans will be semi automated - a full fleged air conditioning solution would cost considerably more and our system does the same for a fraction of the price
- Significant reduction to the energy footprint of the classroom by ensuring the lights and fans are turned off when not needed
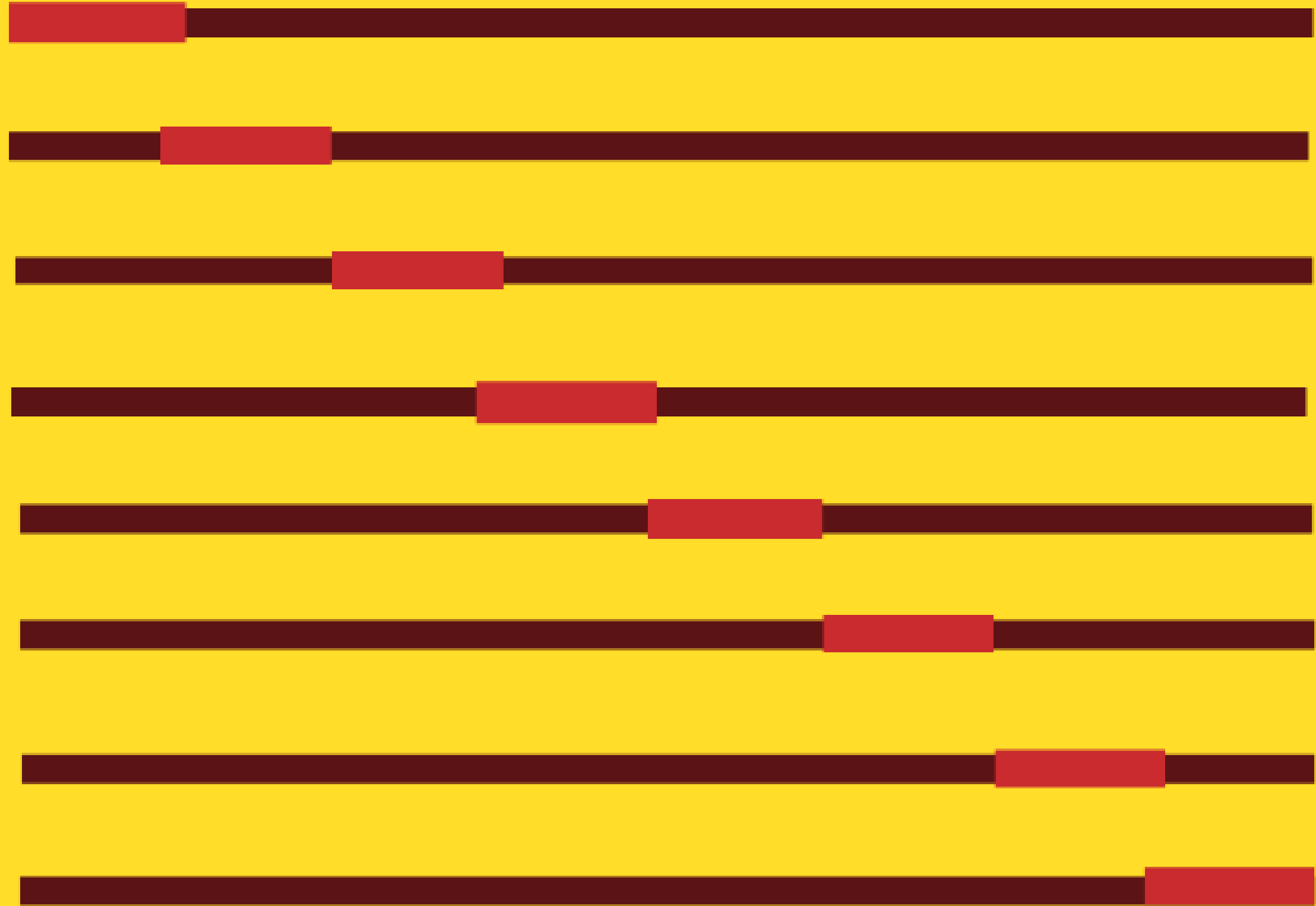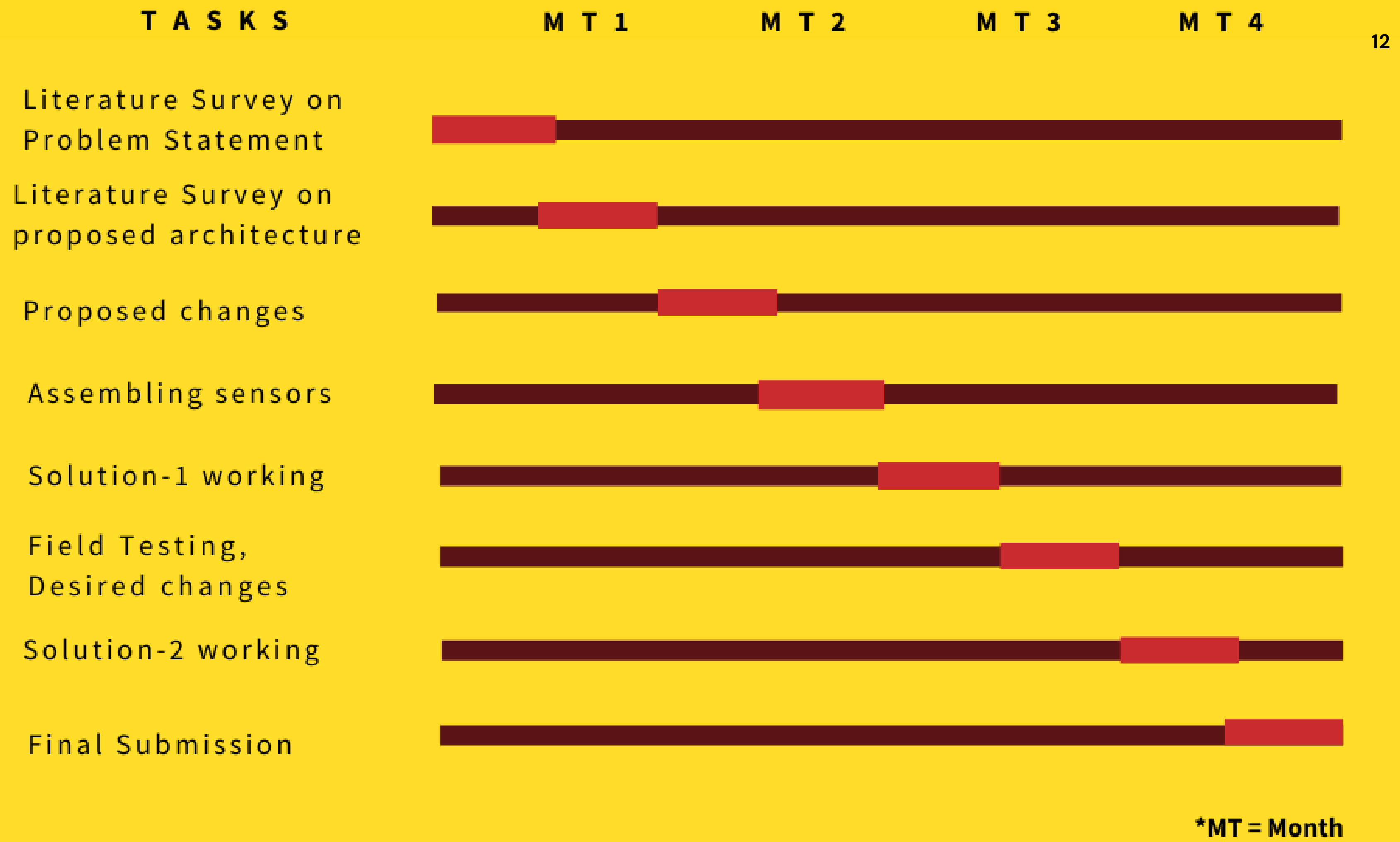
Expected Outcome

- The final goal from this project is to build a real-time solution to power consumption and an overhaul to attendance for our university.

References

1. S. Bhattacharya, G. S. Nainala, P. Das and A. Routray, "Smart Attendance Monitoring System (SAMS): A Face Recognition Based Attendance System for Classroom Environment," 2018 IEEE 18th International Conference on Advanced Learning Technologies (ICALT), Mumbai, 2018, pp. 358-360, doi: 10.1109/ICALT.2018.00090. https://ieeexplore.ieee.org/abstract/document/8433537

2. Suresh S., H. N. S. Anusha, T. Rajath, P. Soundarya and S. V. P. Vudatha, "Automatic lighting and Control System For Classroom," 2016 International Conference on ICT in Business Industry & Government (ICTBIG), Indore, 2016, pp. 1-6, doi: 10.1109/ICTBIG.2016.7892666.https://ieeexplore.ieee.org/abstract/document/7892666