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DEVELOPMENT OF AN IOT PLATFORM

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Abstract: IOT devices and services can be very expensive and time-consuming to set up and manage by an individual or even an organization that deals only with the hardware of these IOT devices. This paper proposes a platform with modular structure that can have multiple parts that work independently to each other, can be hosted and managed by different Technologies or microservices platforms. The basic server structure consists of a main server responsible for a Websockets endpoint and a very basic barebones data api, which exists independently from the server hosting the dashboard that is used to access the data and control the device. The authentication can also be managed separately as we have a database with the only purpose of storing user data. Data in relation to IOT devices is also stored separately in a database, each module has a recommended platform to host and is designed to be as inexpensive to host as possible, by the current (2020-2022) pricing plans of the platforms we can host this platform and its module for free of charge by any individual or organisation. The platform structure is made open source so it's easier for individuals or organisations to cadre to their own use case, being open source also helps in scalability as it can be re hosted by an individual, and the modular design can allow for scaling of different aspects of the platform to levels that cadre to ones use case. An Arduino C library is also designed in order to make it easy for hardware developers to connect their compatible hardware to the platform.

Keywords: IoT Platform, WebSockets, Data Api, Modular, Open Source

I.INTRODUCTION

Internet of Things (IoT) bridges the gap between sensors and actuators. Smart interaction among these devices results in an efficient system which can be employed in various fields. An IoT platform is what enables these systems to have smart interactions and manage data. IoT enables monitoring of data which provides an opportunity for data marketing from where the Big Data concept arises which is a vital key for marketing. Personalizing and standardizing products based on consumer data, for example, would be possible. This will significantly improve marketing companies to adapt to changes, manage resource efficiency, and maintain logistics. As of 2019, there are at least 49 cloud platforms that cater to the needs of different enterprises, end users, government organization, and healthcare but none of the companies address all challenges involved in the implementation and have surged up their service charges. IoT platform development and implementation using a flexible, configurable, modular, lightweight, cost-effective platform is proposed here.

II.LITERATURE SURVEY

Nestor B along with Carlos M. Oppus and Gramata Jr. Jose claro N. Monje published in 2019, this notes introduces the design and implementation of a reconfigurable, scaleable and low costs Iot platform and additionally addresses the challenges that occur during the execution of its cost efficient IoT platform.

Ranjan Sikarwar, Pradeep Yadav, Aditya Dubey published A survey on IOT enabled cloud platforms, this paper provides a literature survey on different IOT platforms and services that are available and gives us an insight on their drawbacks and comparisons between them.

Malihe Asemani, Fatemeh Abdollahei and Fatemeh Jabbari in 2019 published a better understanding of IoT platforms, adds a better understanding of the ways in which cloud computing and IoT platforms works and additionally supplies major characteristics description.

M.Ullah, K.Smolander in 2019 published a paper where the key factors of an IoT platform were highlighted, this paper attempts to find out the chief requirements of IoT platforms that can be considered before choosing an IoT platform and what to look for while opting for services as the existing services cost more. This collective network connects devices and technology provides communication between devices.

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Luca Calderoni, Antonio Magnani in 2019 published IoT manager which is a general framework for managing sensor networks, which has been designed and implemented by the University of Bologna as a case study for an open source IoT platform.

Jongwan An, JaeYoung Hwang, and JaeSeung Song in the year 2016 published a paper “Interworking Technique and Architecture for Connecting LAN IoT Devices Towards Standardized IoT Service Layer Platform”.Taking advantage of interworking technique and architecture towards a standardized IoT service layer platform is a recent publication.This paper highlights the interoperability problems in many house IoT devices by providing an architecture to support interworking between smart home devices.

Ninging cui, Yi hu, Dong Yu, The paper describes how to design and develop an intelligent workshop IoT cloud platform based on microservices in detail, including a detailed description of architecture and design of the platform. Published in 2019 our research and implementation of intelligent workshop IoT cloud platform.

Terry Guo along with Damon Khoo, Micheal Coultis and Marbin Pazos Revilla in 2018 published an IoT platform for engineering research and education. Applications in secure and smart manufacturing. This paper provides insight on the small scale IoT platform built by Tennessee tech. Also includes 2 case study reports 1) machinery health monitoring 2)Intrusion detection at any manufacturing environment which is supposed to be secure.

III.PROBLEM STATEMENT

Interconnection between distributed digital devices and their networks can be very time-consuming and expensive. Many groups follow their own methods of integrating devices without a standard. Owing to the nature of the devices' existence, their security will always be an issue and information they are provided with is very sensitive.
The proposed solution would allow organizations to easily integrate various features and functions into their systems.

IV.METHODOLOGY

Server Environment: The Server Environment is written in Nodejs. Which is an open source and cross-platform runtime environment for JavaScript. It runs on the V8 engine executing JavaScript outside the browser, hosts the Server Environment.
Socket Connections: The Socket Connections are handled by Socket.IO library. It is a JavaScript library used for real time web applications. It also provides a bi-directional communication between server and web clients.
MySQL: Our MySQL tutorial is designed for beginners and professionals. It is cheaper for storing the structural data like sensor values every time.
MongoDB: As device status requires fast read and write speed so that the device responds fast, we use MongoDB which is good for unstructured data like user settings and device status.
Arduino Library: It is a simple high level api to communicate with the web socket connection written in C. We can use libraries to extend the Arduino environment similar to programming platforms in the market. The use of libraries gives us extra functionality.
Hosting: heroku container provider for node enu, vercel for static server hosting to the dashboard, MongoDB Atlas for remote MongoDB instance and GoDaddy mysql hosting for MySQL instance.

V.BLOCK DIAGRAM

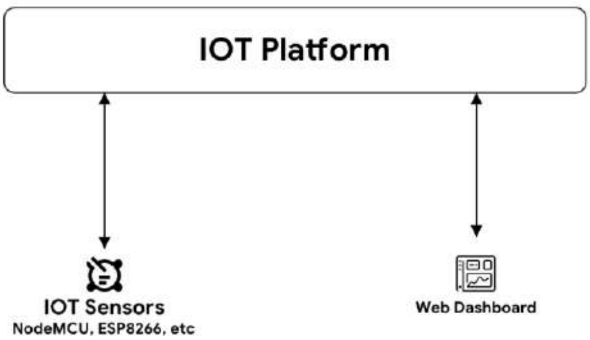

Fig 1: External IoT Platform Block Diagram

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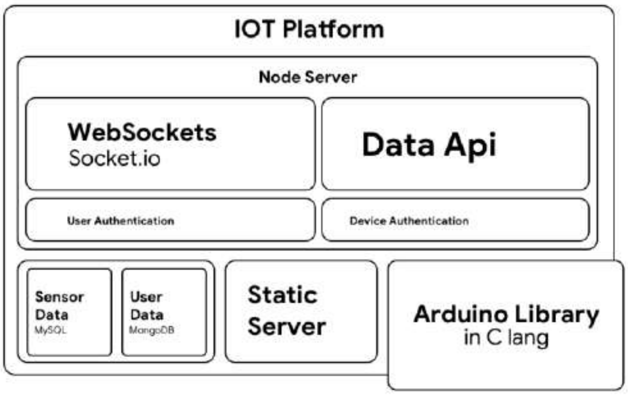

Fig 2: Internal IoT Platform Block Diagram

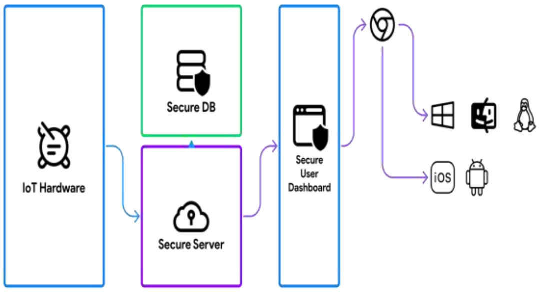

Fig 2: Design Methodology

VI.STRUCTURAL OUTLINE

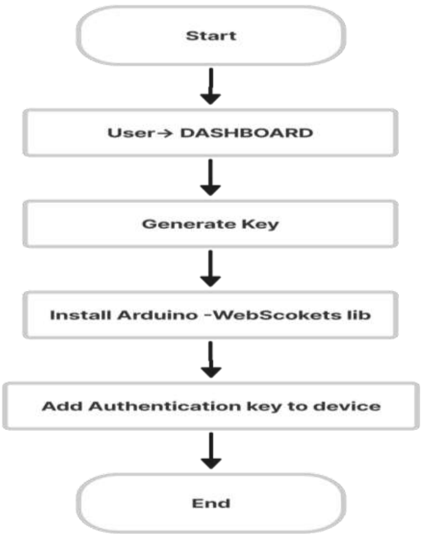

Fig 3: Device Setup

The device setup method is made to be as simple to setup as possible, the platform abstracts the complexity of the setup by giving the user a jwt that needs to be added in the hardware code

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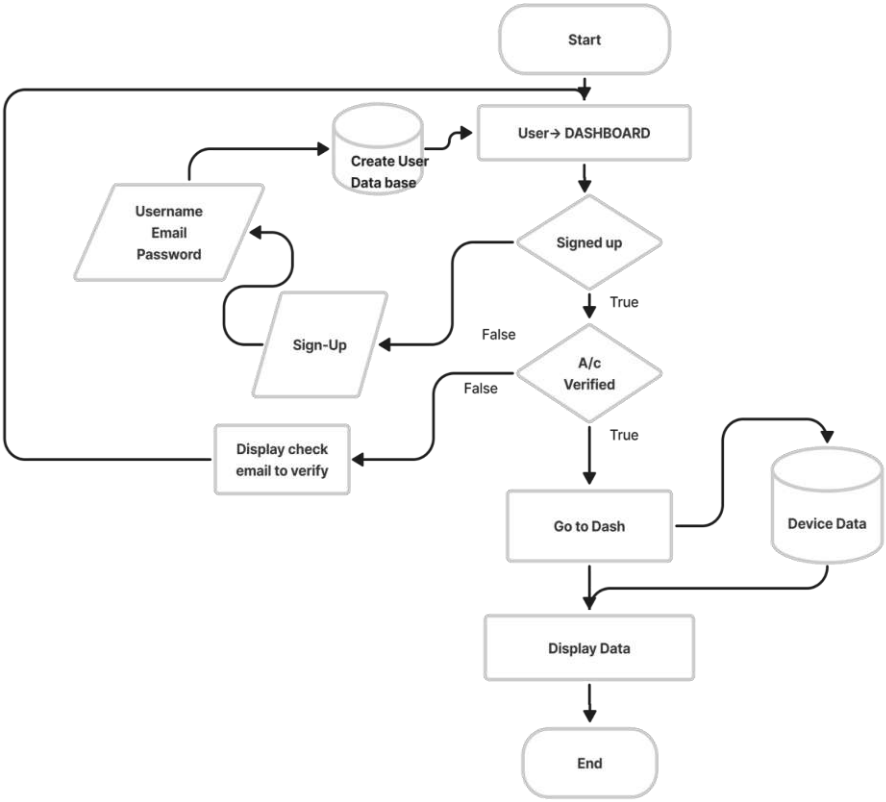

Fig 4: User Authentication Method.

The user authentication method follows standard practices of verification of email before allowing user to login to avoid bot accounts and spam

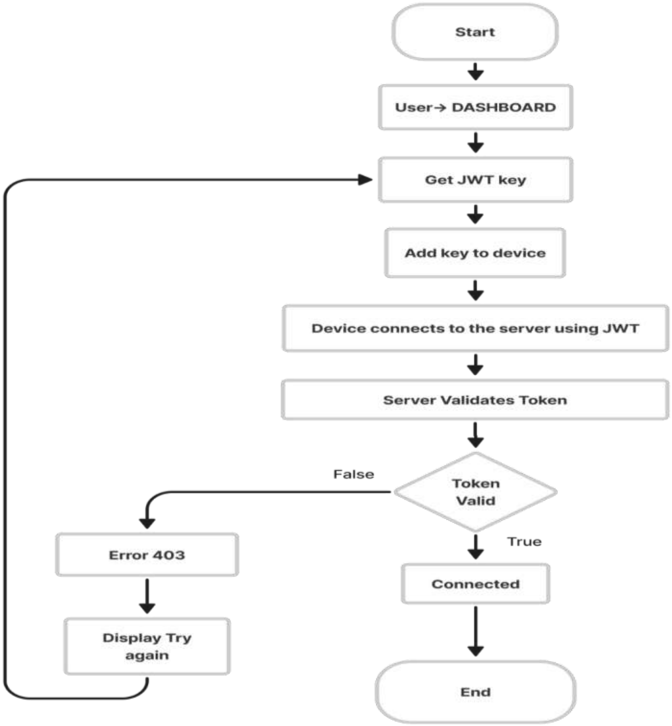

Fig 5: Device Authentication Method.

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The device auth relies on jwt verifications done by the server on any call made by the device, this avoids the server from needing to make any database calls to verify tokens or needing to save the token on any database, this allows for the device connection to still be fast enough for most use cases.

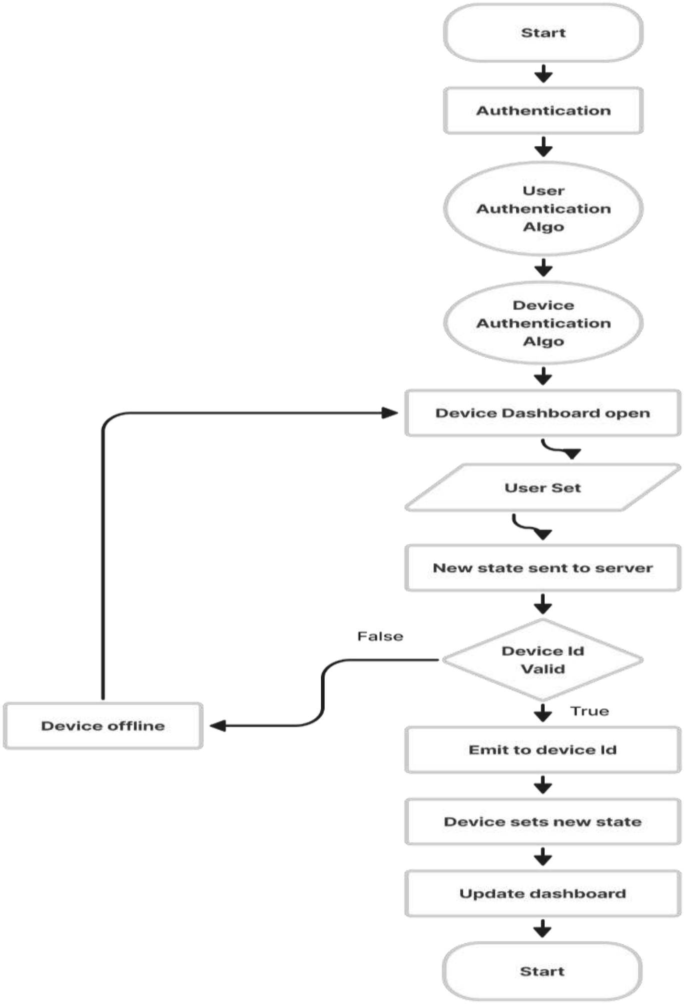

Fig 6: Communication Method.

The communication method uses websockets for the device to stay connected to the server, this connection is validated using jwt and stay updated with its state saved on the database

VII. SYSTEM HARDWARE REQUIREMENT

A. HARDWARE COMPONENTS

Microcontroller Arduino UNO- ATmega328P, with Input Voltage: 7V-12V and Operating Voltage: 5V, Digital I/O Pins: 14 pins (6 reserved for PWM output), Analog I/O Pins: 6 pins, DC Current per I/O Pin: 20 mA, Flash Memory: 32KB (ATmega328P),Clock Speed: 16MHz, SRAM: 2KB (ATmega328P), BUILTIN LED: 13 EEPROM: 1KB (ATmega328P).

ESP8266: (802.11 supporting WPA2 or WPA)2.4 GHz Wi-Fi.
General Purpose input and output (16 GPIO). Analog to digital convertor (10 bit ADC) Inter Integrated Circuit (I^2C) serial communication protocol. Pulse width modulation (PWM) Serial Peripheral Interface (SPI) for serial communication protocol.

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Databases used :
1. MySQL
2. MongoDB

Dashboard:
1. Reactjs

Arduino Library:
1. C language.

VIII. IMPLEMENTATION

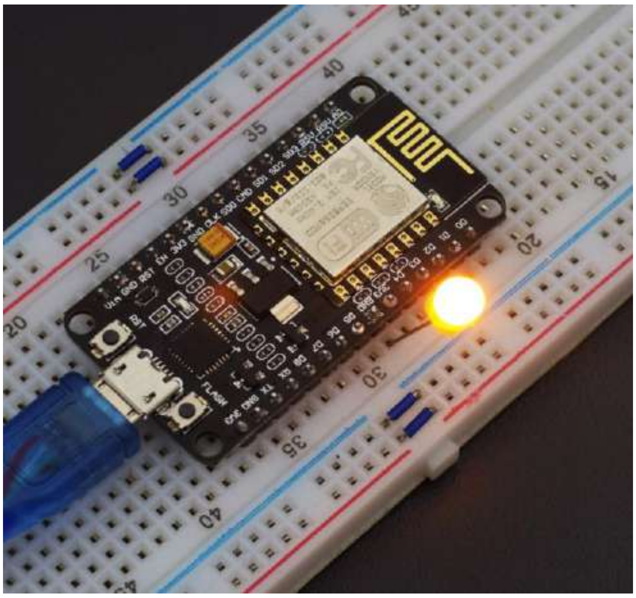

Fig 7: ESP8266

Fig 8: Dashboard- IoT Sandbox

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B. SOFTWARE REQUIRED

Ideal Hosting option (for lowest cost):
1.Heroku.
2. Vercel.
3. MongoDB atlas.
4. GoDaddy MySQL

Server Environment:
1. Written in Nodejs.
2. Socket connection: Socket.io

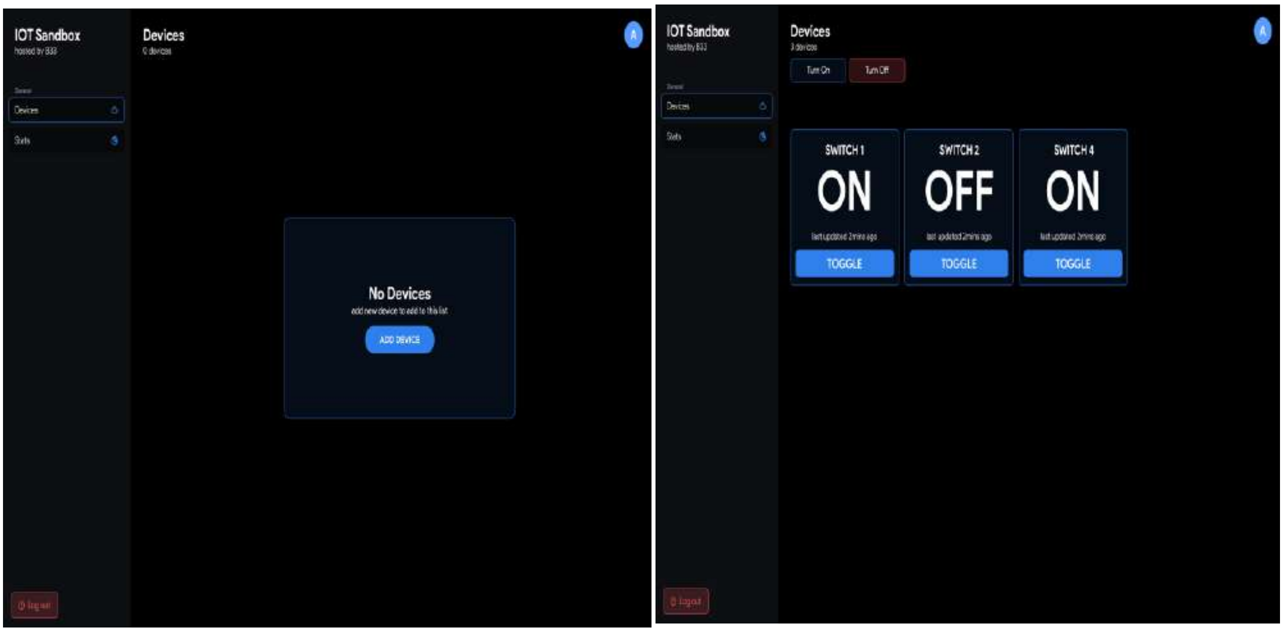

Fig 9: Dashboard with & without devices connected

IX. CONCLUSION

The IoT platform we are designing features a node server consisting of websockets, data api and user and device authentication. The framework for an IOT platform which we are designing is lightweight and might easily be deployed. The deployed platform can allow users to join up and login into the platform where they'll get their api keys that they can use in their hardware design to attach can use in their hardware design to attach safely to the present platform. The connected devices can be controlled pin wise through the Dashboard or is wont to just record sensor data from the device to look at it over time.

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Fig 10:JWT KEY

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