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Artificial Intelligence based IoT Automation: Controlling devices with Google and Facebook

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Abstract - *Everyone has their own definition of the term Internet of Things (IoT); I assume it to be the technology that provides us the ability to bring life into that plain old circuitry so that they can have a smart and simple way to communicate among themselves and with users. Just imagine the fact that we can have real time chat with our home appliances or that good old dc motor over social network from anywhere in the world. The devices can also communicate about their present status with any Artificial Intelligence (AI) of our choice. Let us create a world where not only humans but devices also have their own social network platform where we can command them to perform certain action just the similar way we would ask a person to do a favour and monitor them with more efficiency. In this paper I am proposing a prototype which can be controlled over the internet through Artificial Intelligence of social network like Facebook (Chatbot) and Google (Google Assistant), if required we can also switch our choice of AI over the variety available. The paper also brings an approach towards bridging the gap between social networks (SN) and Internet of Things which enables the connection of people towards ubiquitous automation universe based on Social Internet of Things (SIoT).*

Key Words: **AI Automation, Adafruit, Internet of Things, MQTT, NodeMCU, Social Internet of Things.**

1. INTRODUCTION

Internet of Things has been the hot topic for the last decade. The ability to control physical devices over the internet and monitor sensor values with live feed from anywhere in the world gives us that simplicity, transparency, efficiency and security that is required in both home and industrial automation that our present system lacks. Nowadays, as sensing, actuation, communication and control become even more sophisticated and ubiquitous; there is a significant overlap in the field of IoT, sometimes from slightly different perspectives. The gadgets would weave themselves into the fabric of our everyday life to support us in carrying out daily life activities, tasks and rituals in an easy, natural way using information and intelligence, hidden in the network connecting the gadgets.

With the advent of smart phones, more people are connected with social network, so why not shift the control of devices to a simple chat on Facebook or just speak "OK Google, run motor clockwise", to perform the task.

In this paper, for the prototype demonstrated, Adafruit MQTT broker [1] is used for communication among devices, IFTTT (If This Then That) [2] service is used to configure our AI and Chatfuel [3] is used to create a simple Chatbot. The system developed is also the cheapest solution of its kind as it is build on all open source platforms. For microcontroller NodeMCU [4] is used which have an inbuilt Wi-Fi support and Arduino IDE is used for programming the NodeMCU.

The prototype demonstrated has three modules:

Module 1: Switching home appliances.
Module 2: Control speed and rotation of a DC motor.
Module 3: Live feed of sensor data.

Section II of this paper contains literature survey where a brief about the papers I have studied to write this article is presented. The next section is methodology where I have described in detail the process used in developing the prototype with configuration pictures and circuit diagram. It also contains separate discussion on the AI used, communication protocol, and hardware and software implementation. Section IV contains the result that we can achieve after successful functioning of the prototype. The next section is about the future scope where I have discussed about Social Network and BlockChain implementation into IoT, and the potential they hold for future connected devices.

2. LITERATURE SURVEY

R.Piyare [7] and team has introduced design and implementation of a low cost, flexible and wireless solution to the home automation using Bluetooth. But, Bluetooth has range limitation.

Deepali Javale [8] and team proposed Home Automation using GSM and Arduino which is costlier than the system proposed in this paper and is also based on platform dependent technology.

Chandrappa D N [9] and team implemented a similar concept using MQTT protocol but the paper lacks any direct discussion on using Artificial Intelligence in IoT Automation.

Prof. Niranjan M [10] and team illustrated an IoT based Industrial Automation scenario describing the use of sensors and actuators that can automate the process with

minimum human intervention and the process can be monitored live over the internet.

Ms. C. Hemalatha [11] and team proposed the control of Brushless DC (BLDC) motor using Arduino over the internet, but the system lacks speed and rotation control facility.

Antonio M. Ortiz [12] and team beautifully described the concept of SIoT starting from a general architecture description and going to a deep review of the challenges and open research issues that must be solved to make SIoT a reality.

3. METHODOLOGY

Let us take the example of turning on light, when we say "Turn on light" to the configured AI of Google or Facebook, the following flowchart will come into action:

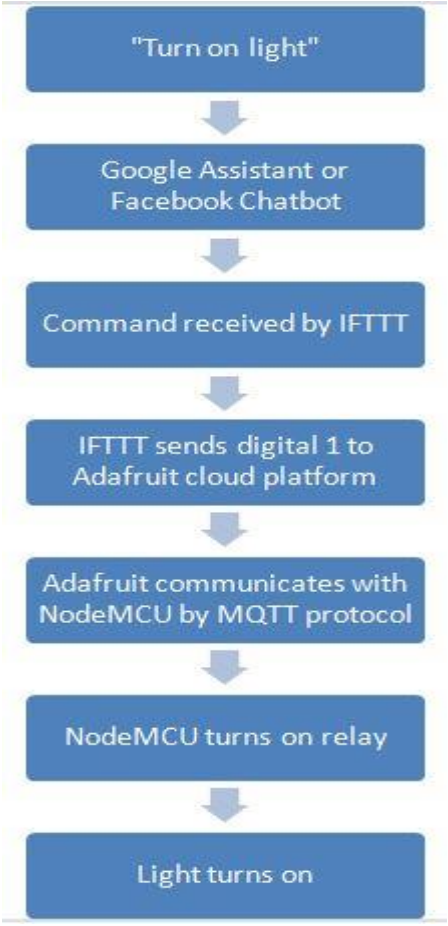

Fig -1: Flowchart of turning on light with AI

3.1 ARTIFICIAL INTELLIGENCE SETUP

To begin with, a Facebook page is created for the appliances and the service of Chatfuel is used to program the page. With few AI rules it is possible to make an autonomous chatbot which can respond and send http request to IFTTT platform. The web hook service on IFTTT is used to accept the request and send corresponding data to Adafruit cloud. For switching purposes 1 and 0 are the values send and for PWM [5] (Pulse Width Modulation) control of dc motor, values ranging from 0 to 1023 are send from IFTTT to Adafruit.

Fig -2: An AI rule on Chatfuel to turn on both the relays.

Chatfuel on receiving command from Facebook would send a post type http request to IFTTT using the JSON API [3]

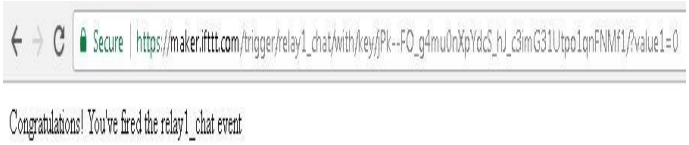

Fig -3: Successful communication between Chatfuel and IFTTT.

Similarly, Google Assistant, Alexa and other Artificial Intelligence service are available on IFTTT platform which can be configured accordingly with Adafruit cloud.

Fig -4: Configuration of Google Assistant on IFTTT

Fig -5: Configuration of Adafruit on IFTTT

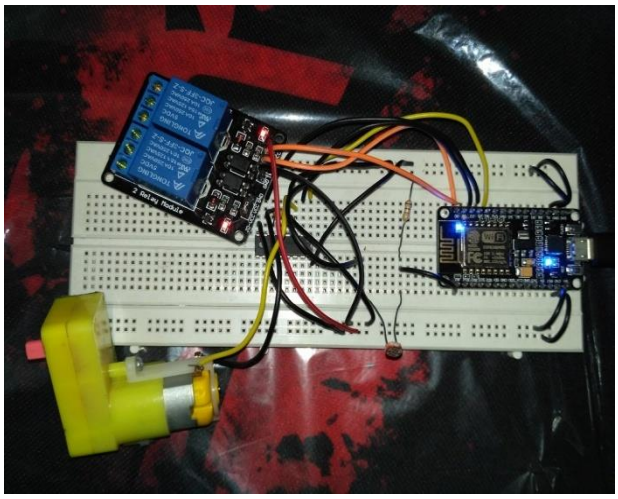

Fig -6: Actual circuit representation.

3.2 MQTT

MQTT or Message Queue Telemetry Transport is an extremely lightweight communication protocol developed by IBM. MQTT have a publish/subscribe design to communicate among machines (M2M). In this project MQTT is used as a message transfer binding protocol. MQTT consists of broker and client. A client is denoted as a subscriber or publisher to/of a certain topic. A subscriber listens to the server whereas a publisher sends value to the server. For the prototype Adafruit service is used as MQTT broker and NodeMCU as the client. Adafruit provides the cloud platform and a control dashboard as well. While programming the client, subscriber and publisher are defined. Relay and dc motor is the subscriber as they listen to the server for external command, whereas the sensor (photocell) is the publisher as it reads data and releases it to the server.

3.3 HARDWARE DESIGN

NodeMCU is the heart of the project. It is the cheapest available microcontroller with inbuilt Wi-Fi support running on ESP8266, open source platform for developing IoT projects. It integrates GPIO, PWM, IIC and ADC all in one board. PWM (Pulse Width Modulation) feature is used for motor speed control [5], ADC (Analog to Digital Converter) is used for reading the sensor data [6]. GPIO (General Purpose Input Output) pins are used for connecting the relay and motor input pins. To run the motor, L293d motor driver IC is used. The IC runs on 3V DC and can support DC motor up to 24V. 5V relays can easily be used for switching home appliances. And NodeMCU requires 5V DC supply to function.

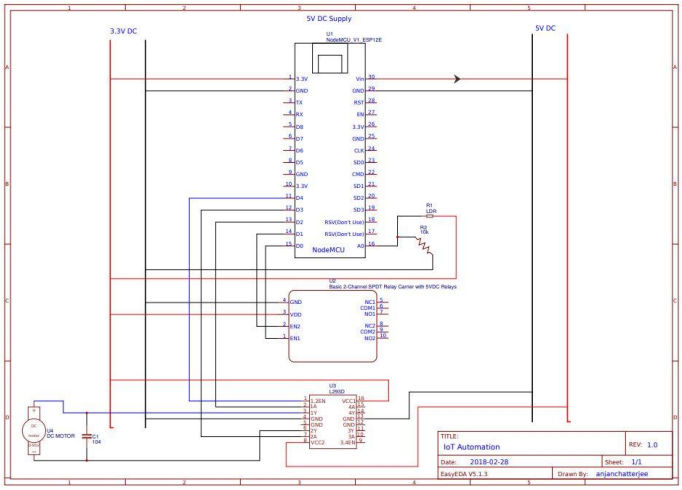

Fig -7: Circuit diagram

3.3 SOFTWARE IMPLEMENTATION

1. Arduino IDE is installed.
2. From preferences ESP8266 board package is installed and NodeMCU 1.0 (ESP 12E) module is selected as the preferred board. Adafruit MQTT Library is also included.
3. Baud rate is set to 115200 and com port is selected accordingly.
4. Pins are defined, one for each relay. Since a single motor is used for demonstration purpose, two input pin and an enable pin for the motor are defined.
5. The SSID and Password of Wi-Fi for the internet connection are mentioned in the program.
6. Server ports are defined for Adafruit setup. For security purpose Adafruit also provides a unique key which is defined in the program.

7. An ESP8266 Wi-Fi client class is created by passing in the login and server details for MQTT server secure client access.

8. Feeds are defined for MQTT paths in the form <username>/feeds/<feedname>. A feed may be defined for publishing values or for subscribing to a certain topic. Likewise, sensor feed is defined as publisher and relay and motor feeds are defined as subscribers.

9. Feeds are updated accordingly on Adafruit cloud platform and state of device can be monitored and controlled directly from there.

10. For Google Assistant, just speak out to Google or type out the action that you want to perform. For Facebook Chatbot, open the respective page of the project and type the command. Each service has their layer of security and can be accessed only via user's account. But the user if required can add multiple people on the platform. This adds security of devices that is mostly feared in the field of Internet of Things.

4. RESULT

After preparing the setup, end user may communicate with the hardware from anywhere in the world using the configured AI. It should be made sure that the hardware receives adequate power supply. In this case, a simple Facebook chat or a Google assistant voice command from any Smartphone device can trigger the hardware as shown in Fig. 7 and Fig. 8.

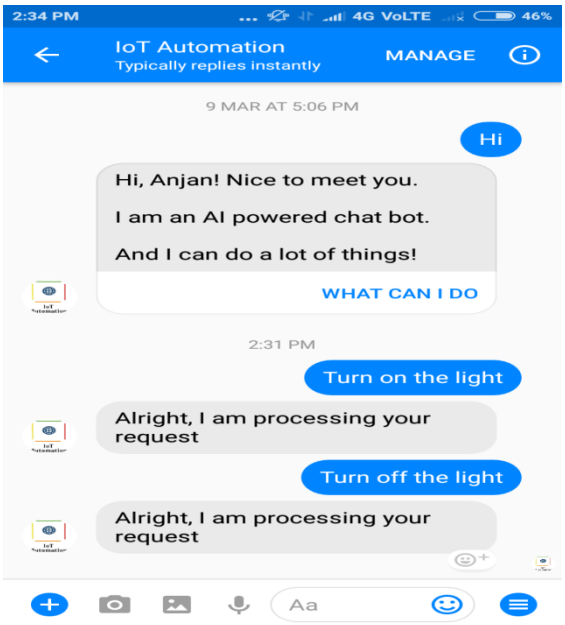

Fig -8: Real time Facebook chat with device

Fig -9: Real time Google Assistant chat with device

The AI of choice would channel the request of end user via IFTTT (If This Then That) service to Adafruit cloud platform. Adafruit is integrated into the hardware using MQTT protocol as explained before. So we can monitor any connected devices to NodeMCU and their live status on Adafruit dashboard. We can also control our devices from there.

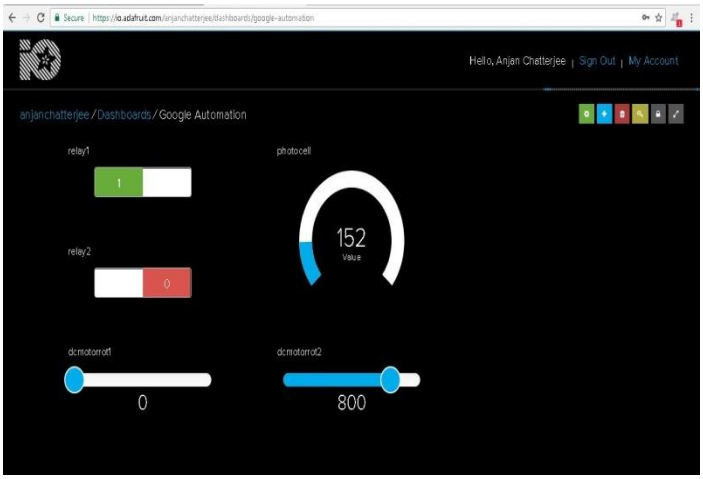

Fig -10: Adafruit control dashboard

5. FUTURE SCOPE

5.1 SOCIAL INTERNET OF THINGS

With their last decade spent on connecting people with each other, social media giants and other organisations are now looking at the coming ten years to connect people to their devices and gain valuable insight from it. As enterprises around the world seek an efficient way to monitor, listen, and analyse data gathered from social

media, IoT offers them a convenient method for social data aggregation without affecting their time and energy. By gathering valuable insights with the help of IoT-connected social media monitoring tools, businesses can make informative and crucial decisions across a variety of internal departments.

In order to practically integrate the ubiquitous computing in our future daily life with high Quality of Experience [12], we need to improve the connectivity of all the relationships between users and things, and to enhance the availability of computational power via sets of things surrounding us. Therefore, we take into consideration social networks (SNs) of all entities (i.e., humans and things) for ubiquitous computing as an evolution beyond the IoT. In other words, things should be socialized for allowing humans to establish relationships with them in an easy way. It does not only mean physical connections between humans and things, but also logical configurations of social communities involving humans as well as things. This logical configuration can be realized through exhibiting features from people's SN and adopting them for the suggested universal SN of all entities. The future SN of things can include the interactivity scheme, profiling system, recommendation, and mash up of services that include both human and machine on the same platform.

5.2 BLOCKCHAIN INTO IOT

The blockchain-based approach, being trust-free is becoming a central feature of people's relationships. The Economist describes blockchain (BC) as "the trust machine", indicating that it takes care of trust issues between individuals (Economist 2015). In other words, the economic system, which is built on blockchain technology, runs without people, thus making a transaction "trust-free." Historically, trust has underpinned business, often involving a reliable third party, which is expensive. Blockchain technology provides a viable alternative to eliminate intermediaries, thereby lowering operational costs and increasing the efficiency of a sharing service, such as a SIoT enabled device in the perspective of this paper. With blockchain technology, the world's most fundamental commercial interactions can be re-imagined; the door to invent new styles of digital interactions in trust-free sharing services has been opened.

IoT devices would benefit from a private immutable ledger that acts as per the technology of peer to peer, but can be managed centrally, to optimize energy consumption [13]. BlockChain (BC) holds promise for privacy and security in IoT. However, applying BC in IoT is not straightforward due to various associated challenges including: high resource consumption, scalability, and processing time. High resource devices create an overlay network to implement a publicly accessible distributed BC that ensures end-to-end security and privacy. It employs a hierarchical architecture that uses a centralized private Immutable Ledger (IL) at the local IoT network level to reduce overhead, and a decentralized public BC at higher end devices for stronger trust. A distributed trust method is employed to decrease new block processing overhead. Security and privacy of the design could be evaluated that shows the robustness of the new architecture against several attacks. Security in IoT is challenging due to low resource capabilities of the vast majority of devices, immense scale, heterogeneity among the devices, and lack of standardization. Moreover, many of these IoT devices collect and share large amounts of data from our personal spaces, thus opening up significant privacy concerns. BlockChain can come into effect at this stage to protect user's privacy, by anonymizing the data and its origin. This security requirement is necessary since we are standing on the brink of an era with real ubiquitous computing and communication where many gadgets, such as sensors, RF identification (RFID) tags, and smart electronic/electromechanical devices, surrounding us will be on the real-time network.

6. CONCLUSIONS

In this paper, the system proposed is a smart way of integrating electronic appliances with our daily life. The paper implies on using Artificial Intelligence along with the Internet of Things but it also shows an approach to the new world of Social Internet of Things (SIoT), where the potentialities of social networking concepts can be merged with IoT so that a physical appliance can be integrated directly into a social platform. The resulting paradigm has the potential to support novel applications and networking services for the IoT in more effective, efficient and secure ways. The technology can be beneficial for establishment and management of social relationships between objects in such a way that the resulting social network is navigable just like humans are connected on social media. The paper also describes a possible architecture for the IoT that includes the functionalities required to integrate things into a social network.

The technology of BlockChain can also be utilised to develop a cryptic ledger of millions of devices across the globe so that they can socialize among themselves and end users with secure and private design and help devices to learn about human preferences and function accordingly. A lot of work is required in this field so that in future we can have a social media dedicated to physical devices which are also connected on BlockChain so that they can communicate among themselves and take decisions and make human machine interaction to the next level of innovation.

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in the field of Internet of Things and are committed towards making the world more connected than ever. And lastly I would like to acknowledge the work of all the authors whose paper I have referred towards developing this project.

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