# Arduino Based Home Automation System Using MQTT Protocol Incorporating Internet of Things (IOT)

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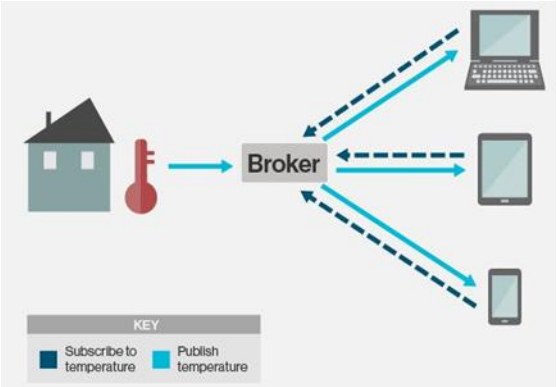
**Abstract – In recent years, the home environment has seen a rapid introduction of network enabled digital technology. This technology offers new and exciting opportunities to increase the connectivity of devices within the home for the purpose of home automation. Home automation refers to control of home appliances using information technology. With the help of rapid expansion of the Internet, there is the potential to control and automate the home appliances. It is achieved by interfacing the internet with embedded systems. This paper deals with the idea of implementing the Arduino based interactive home automation system through internet of things inorder to measure temperature, smoke, light and intrusion . Through this project we will be able to secure our home, reduce the wastage of water and electricity.In this project, we will also use the MQTT(Messaging Queuing Telemetry Transport) protocol which is considered a safe and secured protocol.It is an ISO Standard (ISO/IEC PRF 20922 ) publish-subscribe based messaging protocol. It works on top of TCP-IP protocol.**

## 1. INTRODUCTION

As the user demands for communication between the home and the outside world increase, the requirement for (IOT) for home automation have also increased. As a result, IOT technologies have accelerated the development of communication protocol as well as sensor for home automation system. Currently home automation system platforms, which collect data from the sensors and appliances using commercial-of-the-shelf (COTS) wireless technologies, have been developed along with the IOT technologies. For Example: fire alarms and intrusion warning in home automation system need their data to be transmitted as quickly and reliable as possible. Hence, time synchronization between nodes is so crucial that it can severly affect the performance of the home automation system.

## 2. MQTT (MQ Telemetry Transport)

MQ (MQ Telemetry Transport) is a lightweight messaging protocol that provides resource-constrained network clients with a simple way to distribute telemetry information. The protocol, which uses a publish/subscribe communication pattern, is used for machine-to-machine (M2M) communication and plays an important role in the internet of things (IoT).




## 3. HOW MQTT WORKS

An MQTT session is divided into four stages: connection, authentication, communication and termination. A client starts by creating a TCP/IP connection to the broker by using either a standard port or a custom port defined by the broker's operators. When creating the connection, it is important to recognize that the server might continue an old session if it is provided with a reused client identity.

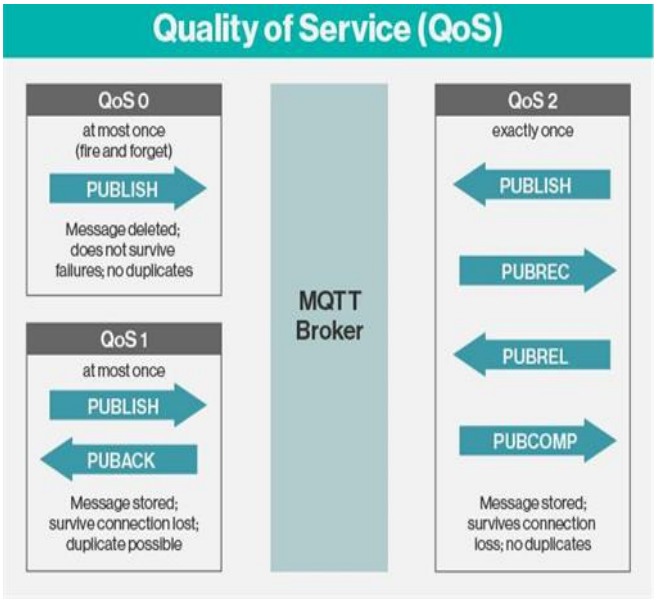
The standard ports are 1883 for non-encrypted communication and 8883 for encrypted communication using SSL/TLS. During the SSL/TLS handshake, the client validates the server certificate to authenticate the server. The client may also provide a client certificate to the broker during the handshake, which the broker can use to authenticate the client. While not specifically part of the MQTT specification, it has become customary for brokers to support client authentication with SSL/TLS client-side certificates.

Because the MQTT protocol aims to be a protocol for resource-constrained and IoT devices, SSL/TLS might not always be an option and, in some cases, might not be desired. In such cases, authentication is presented as a clear-text username and password that is sent by the client to the server as part of the CONNECT/CONNACK packet sequence. Some brokers, especially open brokers published on the internet, will accept anonymous clients. In such cases, the username and password are simply left blank.

MQTT is called a lightweight protocol because all its messages have a small code footprint. Each message consists of a fixed header – 2bytes -- an optional variable header, a message payload that is limited to 256 MB of information and a quality of service (QoS) level.

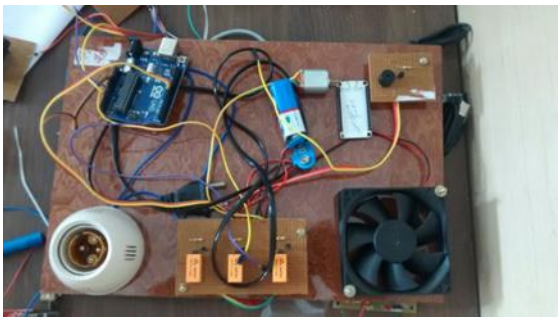
The three different quality of service levels determine how the content is managed by the MQTT protocol. Although higher levels of QoS are more reliable, they have more latency and bandwidth requirements, so subscribing clients can specify the highest QoS level they would like to receive.

The simplest QoS level is unacknowledged service. This QoS level uses a PUBLISH packet sequence; the publisher sends a message to the broker one time and the broker passes the message to subscribers one time. There is no mechanism in place to make sure the message has been received correctly, and the broker does not save the message. This QoS level may also be referred to as at most once, QoS0, or fire and forget.




## 4. SYSTEM IMPLEMENTATION

A sample implementation of the proposed time synchronization system is illustrated in the fig. As depicted, a home automation system is designed for monitoring and controlling devices.



A general home gateway collects information from household devices being provided to the user and relays the user's control commands toward household devices in an IP network environment.

### A. ARDUINO

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single board microcontroller and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or Breadboards (*shields*) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an Integrated Development Environment (IDE) based on the Processing language project.

B. HOME AUTOMATION DEVICES

To determine the feasibility and effectiveness of the proposed system, three devices were developed: a fire detector, bulb controller and integrated environmental sensor.

a) b) c)

LDR sensor PIR Sensor Gas Sensor

*Fire Detector*: A conventional fire alarm is integrated with an Arduino microcontroller, A gas detector is a device that detects the presence of gases in an area, often as part of a safety system. This type of equipment is used to detect a gas leak or other emissions and can interface with a control system so a process can be automatically shut down. A gas detector can sound an alarm to operators in the area where the leak is occurring, giving them the opportunity to leave.

*Bulb Controller*: A prototype bulb controller glows whenever there is a change in the LDR value . User can remotely monitor and control the state of the lamp.

*Environmental Sensor*: A prototype sensor incorporated four types of sensor: temperature- humidity, luminance, $CO_2$, and $NH_3$ sensors was developed and integrated with an RS485 communication interface.

## 5. ADVANTAGES

- The sensor networks are programmed with various user interfaces suitable for user of varying ability and for expert users such that the system can be maintained easily and interacted with very simpy.
- The developed system is robust and flexible in operation. The system was to perform the remote monitoring and control of appliances effectively. Local and remote user interfaces are easy to handle by a novice consumer and are efficient in handling the operation.
- Depending on the inhabitant usages, appliances connected by smart sensing units are controlled by automation based on the tariff conditions or by the inhabitant locally using GUI and remotely using the website.

## 6. LIMITATION/ DISADVANTAGE

- Energy consumption control mechanism is limited to only certain devices like: light illumination, whereas several household appliances possible to controlled
- Energy control is based on fixed threshold power consumption, which may not be applicable to different consumers.
- Controlling the home appliances through network management functions, in practise inhabitant requirements may vary according to their behaviour but not with network characteristics. Not a single system has taken into consideration of variable tariff of electricity, which is consumed throughout the day and night.

## REFERENCES

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