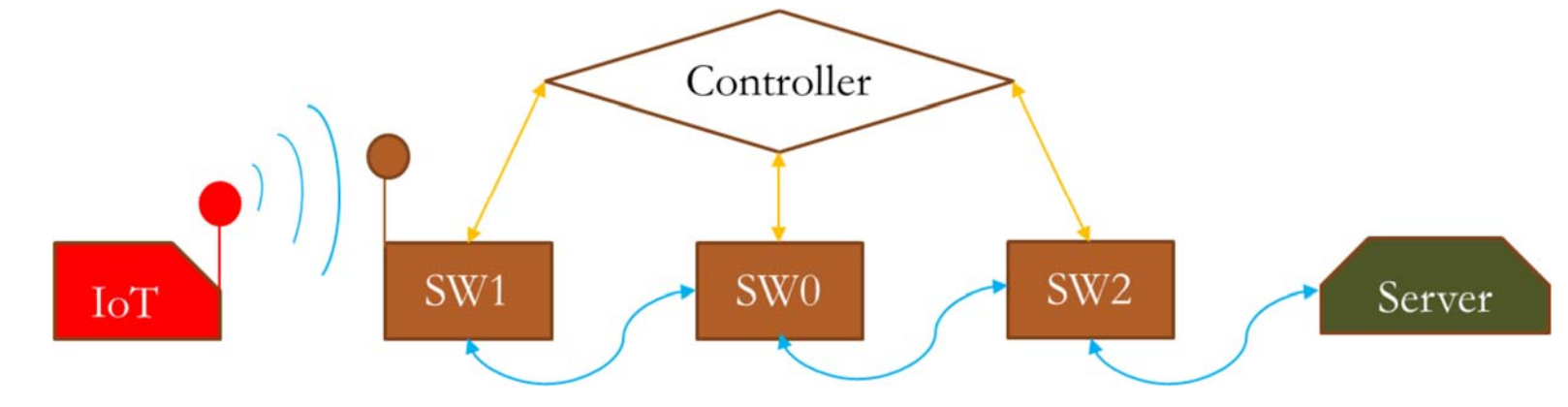




# Improving Security of IoT Devices on SDN

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## Background

SDN is an umbrella term encompassing several kinds of network technologies aimed at making networks as agile and flexible as the virtualized server and storage infrastructure of the modern data center. It allows network engineers and administrators to respond quickly to changing business demands. IOT is a rapidly growing network of physical devices often made up of sensors and actuators embedded in physical devices, which are linked through wired and wireless networks, often using the same IP that connects the Internet.

## Materials and Method

- 5 Raspberry Pies Model B
  - 10 USB to ethernet adapters
- Router
- WIFI enabled Arduino used to make an IOT Device
- RGB led strip

First one raspberry pie was used as a RYU controller. Then three raspberry pies were setup as a SDN switch with the first being a WIFI access point as well as a switch. Then the fifth pie was made into a webserver and MySQL database. Last the IOT device was made which was connected to the network and communicated with a database to update values on the device. The device values were changed by accessing a website which changed the values on the database.

## Definitions

- IoT – Internet of Things
- SDN – Software defined network
- IP – Internet Protocol
- RYU – SDN controller software
- Raspberry Pie – Small Computer
- Arduino – Development board
- Php – Coding language

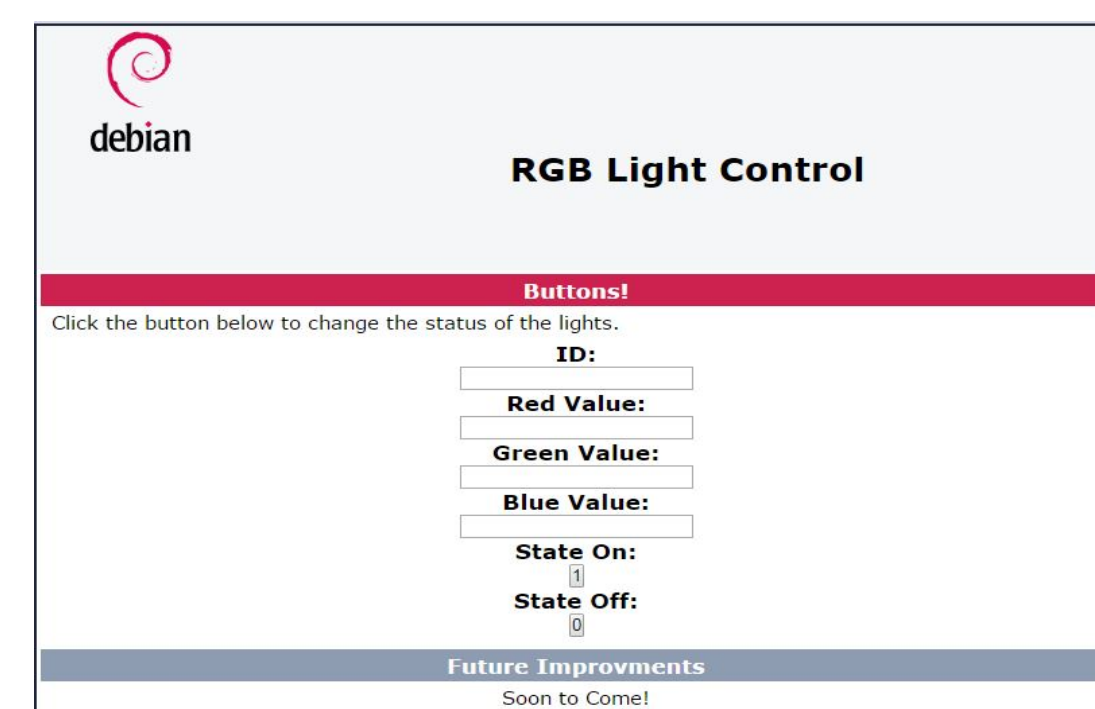


Image 2: Web Light Interface

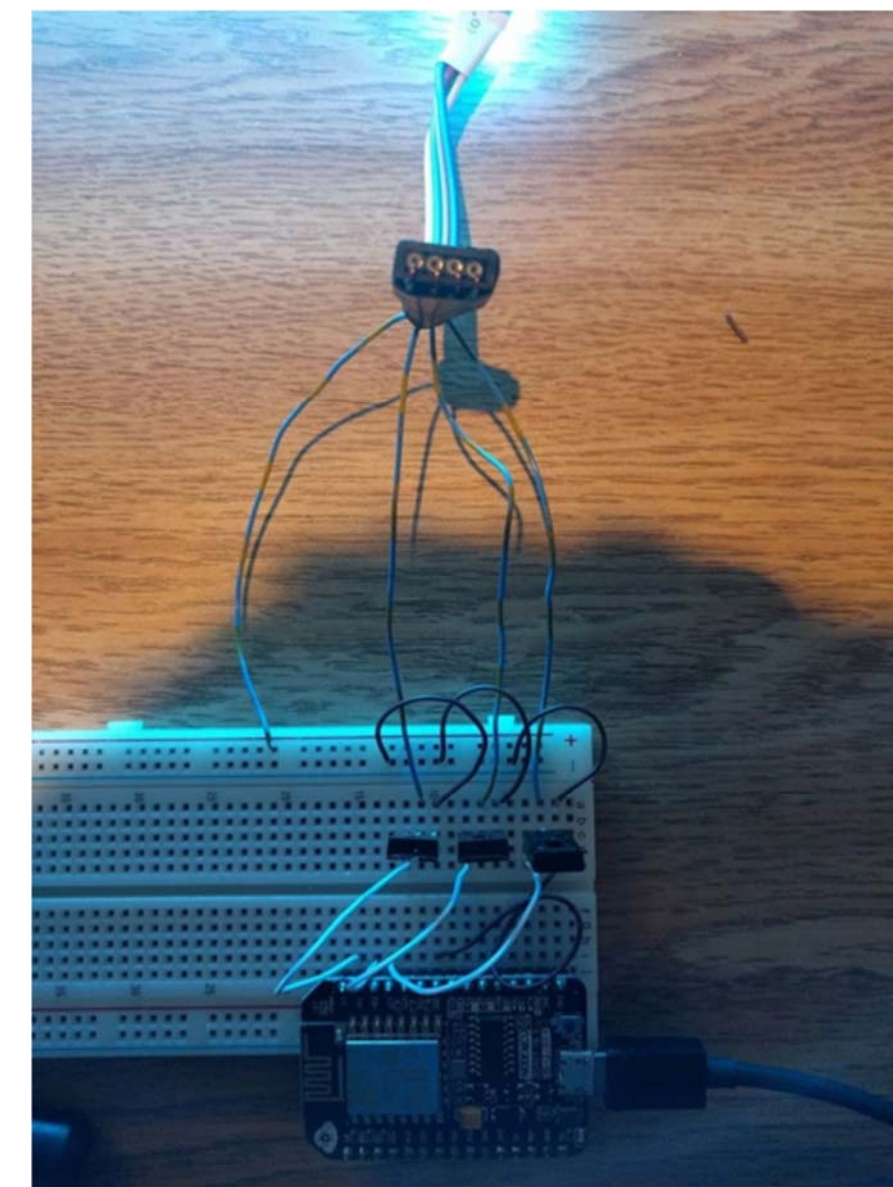


Image 3: Internet of Things Device

## Results

Image 1 to the right is a fully functioning SDN. From the image the raspberry pie to the far right is the web server, an RYU controller to the left of that, SDN openvswitch 2, then SDN openvswitch 0, SDN openvswitch 1 on the far left.

Image 2, the website on the left

Controlled the IOT device seen in Image 3.

The information that was entered on the website, communicated with the database, Image 4. Some of the code need for the communication of the database is below, Image 5. This small section of code made the initial connection between the database and website.

```

connect.php - Notepad
File Edit Format View Help
<?php
mysql_hostname = "127.0.0.1";
mysql_username = "root";
mysql_password = "raspberrypi";
mysql_database = "light";
mysql_port = "3306";

mysql = new mysqli(mysql_hostname, mysql_username, mysql_password, mysql_database, mysql_port);
if (mysql->connect_errno) {
    echo "Failed to connect to MySQL: (" . mysql->connect_errno . ") " . mysql->connect_error;
}

echo mysql->host_info . "\n";
?>

```

Image 5: Connect 'php' script

## Conclusion

With the use of post requests on html you can have a simple encryption for sending data to a server. Adding another layer of encryption to the post request will increase security but also add weight to the overall program. Therefore the amount of space available on the device will determine the complexity of the algorithm used to secure the device.

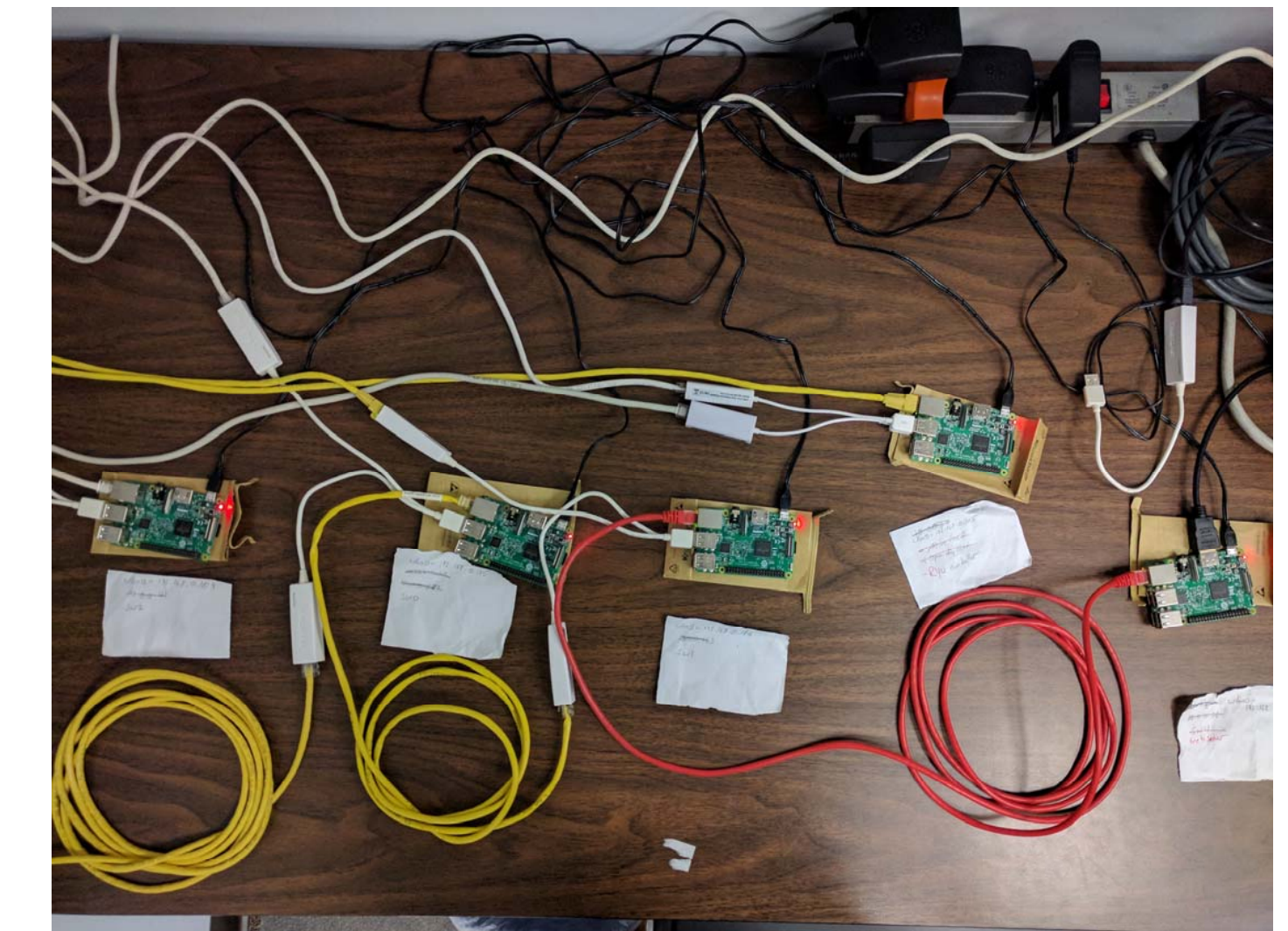


Image 1: Software Defined Network

## Future Work

- Compare encryption algorithms
- Enable more IoT devices on network
- Secure devices over multiple networks
- Look at an IoT mesh network

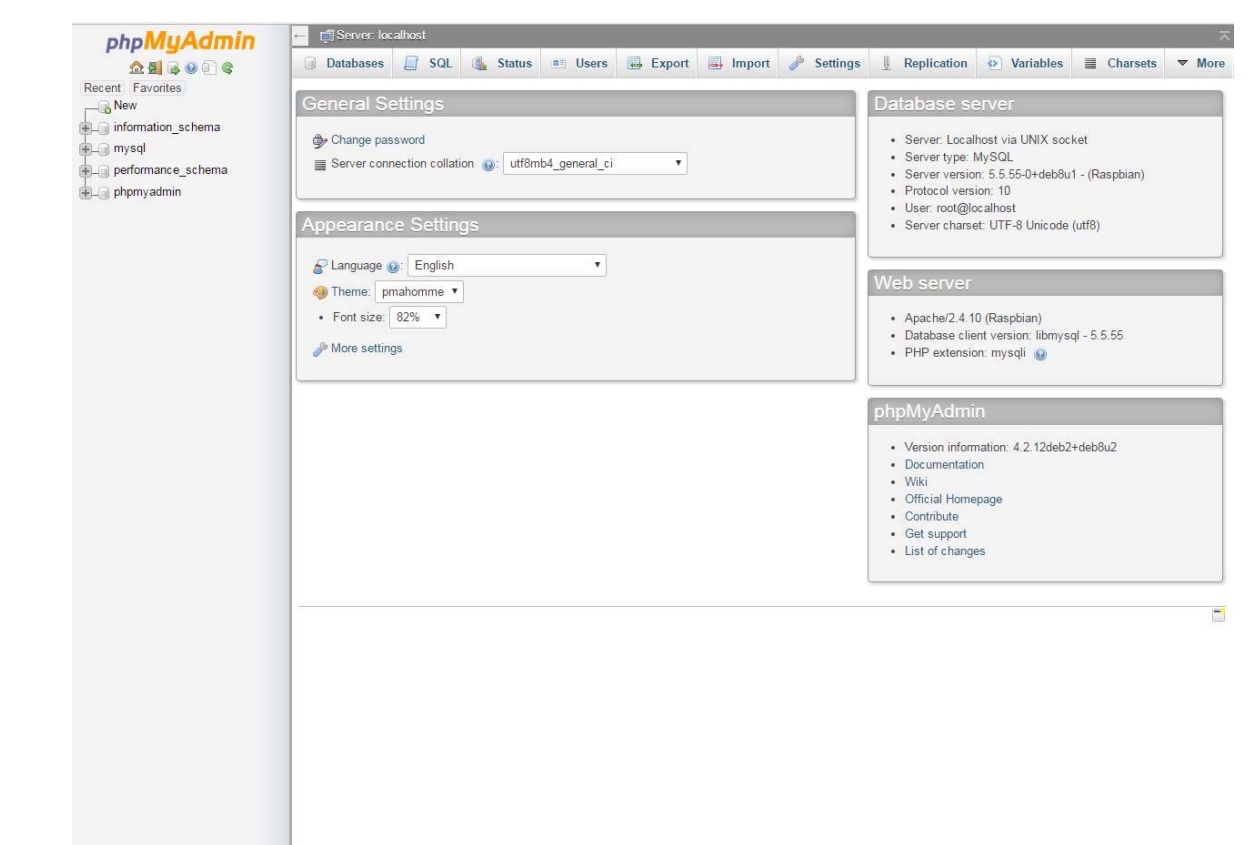


Image 5: Database interface

## Acknowledgments

Mark Morton, Computer & Electrical Engineering Department