

PLUGSi

Smart Modular Power Outlet



Presented by
KOS Tronics

About Us

We are a group of undergraduates from the Department of Electronics and Telecommunication Engineering, at University of Moratuwa.

We are pleased to announce the development of our latest innovation, a modular smart power outlet. Our primary objective with this product is to offer users complete control over their power outlets by employing a diverse range of modules.

Our smart power outlet is a result of tireless research and development, and we are thrilled to offer it to you. It features an extensive range of modular components that can be tailored to suit your precise requirements, all of which connect to a base.

Our product is designed to be flexible and adaptable, allowing it to grow and change alongside your needs. To achieve this level of flexibility, we have introduced each module separately, making our smart power outlet a versatile and customizable solution for all your power needs.

Revolutionizing Smart Power Outlets

Hidden Problems in Modern Culture

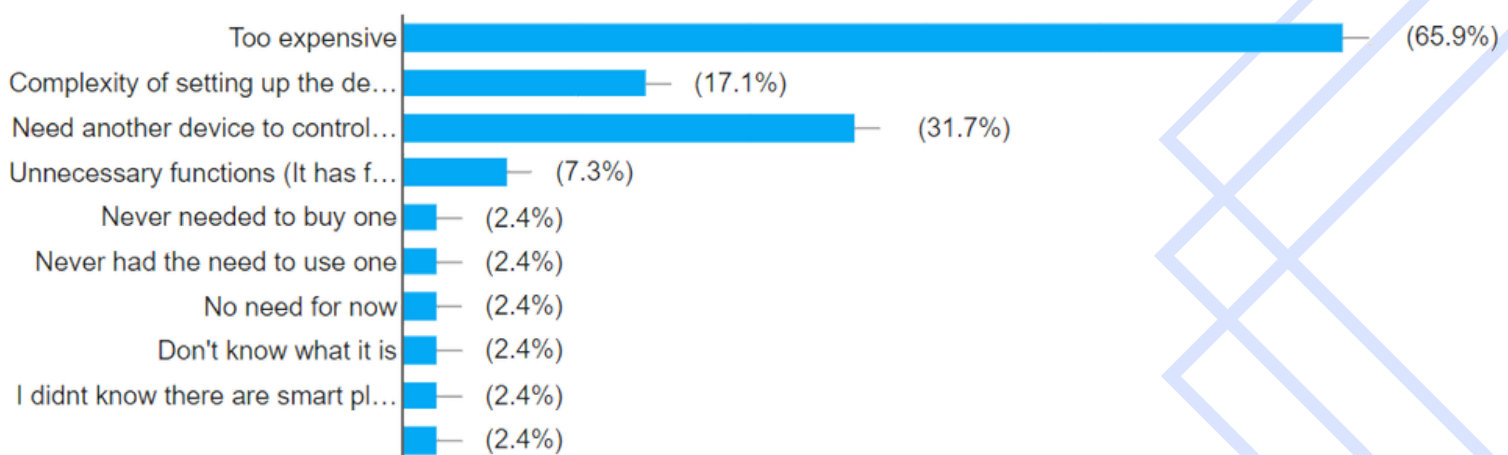
The world is rapidly advancing towards a future where smart technologies are becoming ubiquitous in our daily lives. However, despite this technological progress, there are still many devices and appliances that do not have smart capabilities. One such example is the power outlet. While there have been some attempts to create "smart" power outlets, the majority of them do not live up to the level of sophistication that we have come to expect from modern technology.

Many of these devices are simply glorified timers or remote switches, which can only turn appliances on and off at predetermined times or via a smartphone app. This lack of innovation in the power outlet space is surprising, given the potential benefits of smart power outlets. Despite these challenges, there are still some promising developments in the smart power outlet space. As technology continues to evolve and more people embrace the benefits of smart homes.

Problems with existing solutions

- Not customizable
- Not repairable
- Complexity of setting up the device
- Need additional devices to operate (like ALEXA AI device)
- Too Expensive
- Unnecessary functions

We conducted a survey and this is the result



We came up with a solution!

The solution we propose is a smart modular power outlet to which the user can attach modules as needed.

In our proposed solution, users can get the smart power outlet base for a low price and then add up the required and additional modules as needed.

Manufacturing a purpose specific solution can be costly because number of products is small but manufacturing a general solution that can be made purpose specific is ideal for that problem.

But how..?

The device is consisted of two main parts.

- Power Base
- Modules

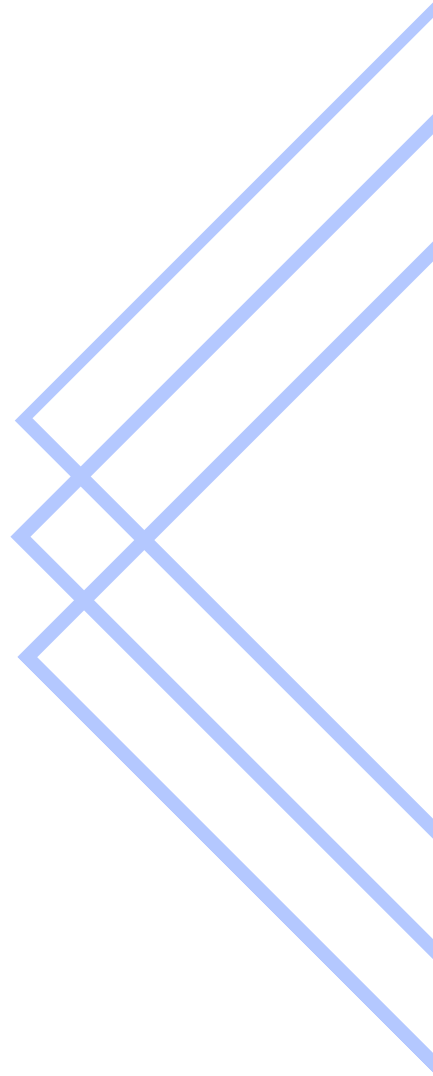
Modules

Modules can be attached to and detached from the Power Base. Modules will control the state of the Power base. Modules can have a variety of abilities based on their design. Multiple modules can be connected to the same Power Base. Some examples for Modules are,

- Bluetooth Module
- Reprogrammable Timer Module
- Set Timer Module
- Wireless Switch

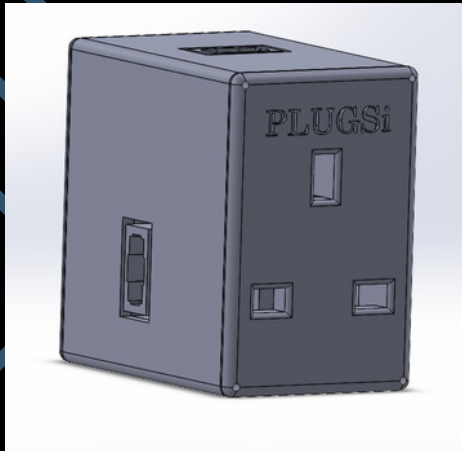
Power Base

Power Base will be connected to a power outlet and any utility (device) can be connected the Power Base. The Power Base will control the AC supply to the device and provide power to modules. Power Base will have a port (interface) to communicate with the modules.

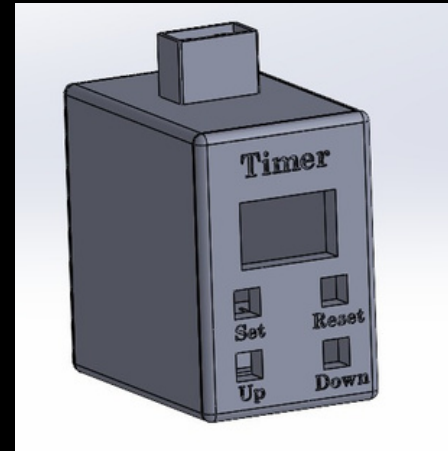


Physical View

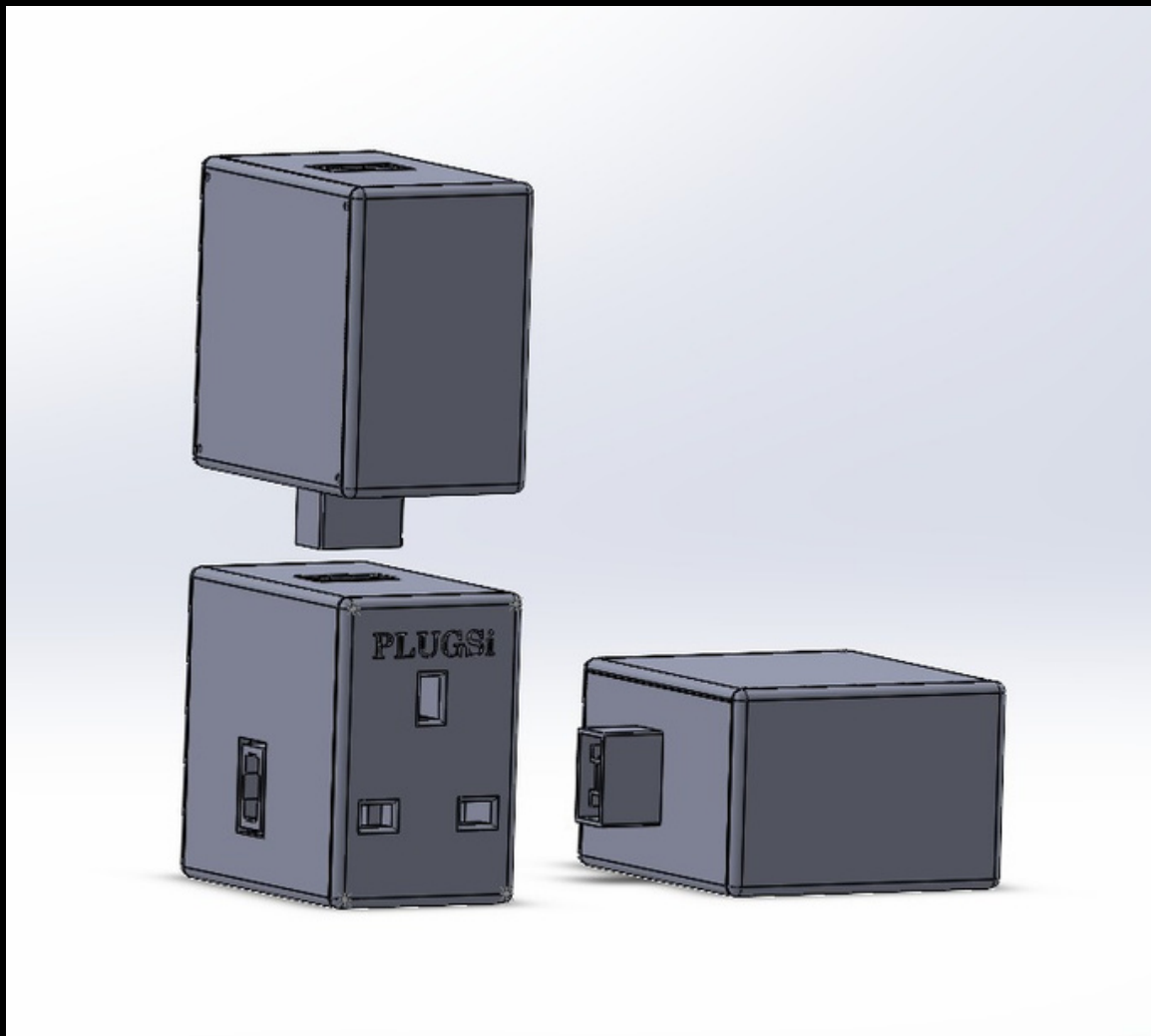
Power Base



Modules



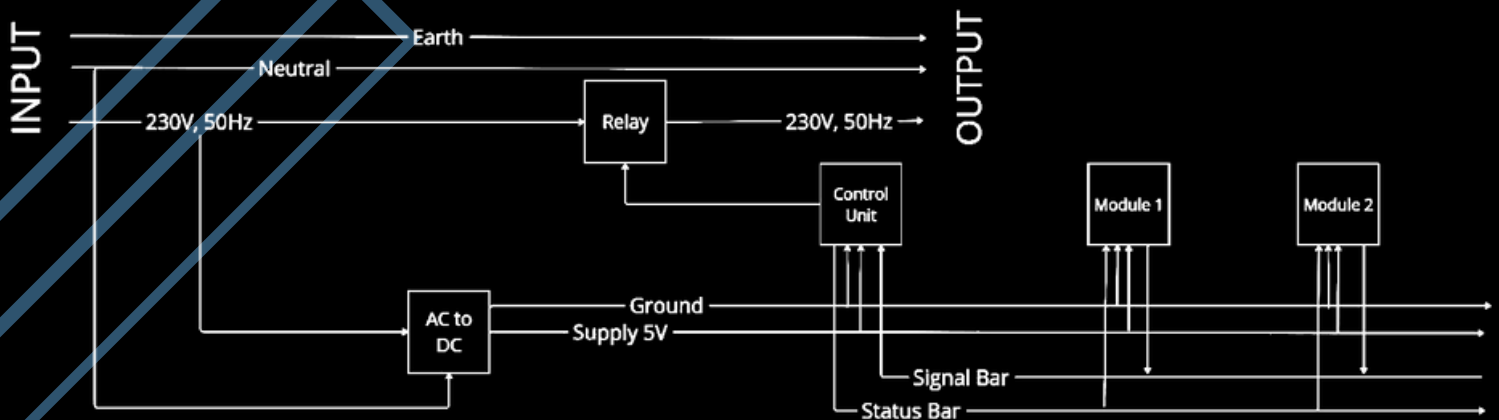
Dimensions 4 x 6 x 6 cm



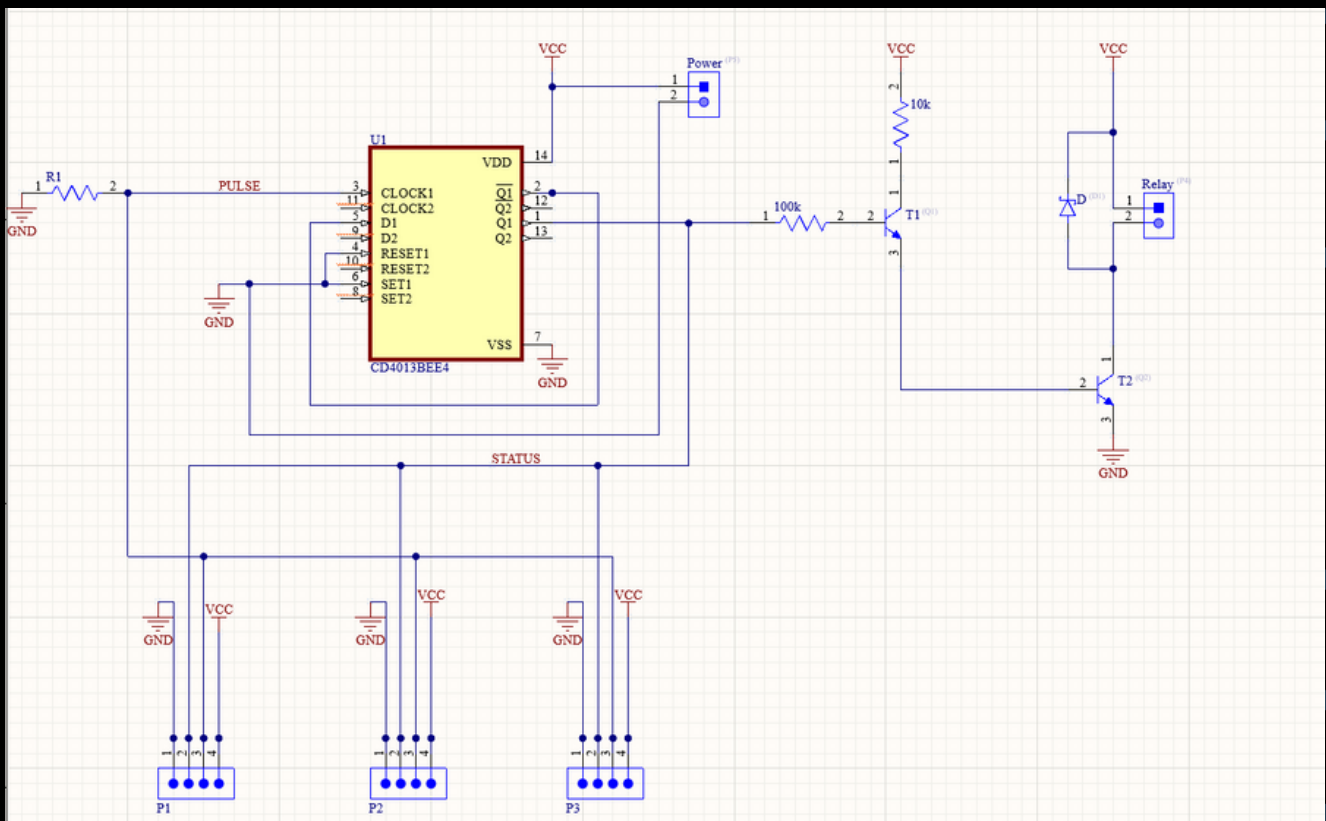
Operating Concept

The module is designed to issue a command using a pulse signal, and it will perform a status check prior to generating the pulse signal. In the event that the power base has reserved a pulse, the base will modify the current state of the relay.

This functionality is achieved through the implementation of a pulse-based communication protocol and the integration of status monitoring and relay control mechanisms within the module's architecture.



Block Diagram of the Power Base



Schematic of the Power Base

Base

There is a D flip-flop in the base, and it controls the relays. There is a transistor circuit to prevent relay taking power from D flip-flop. The command channels from the modules are connected to the clock pin of the D flip-flop.

Commiuncation

First the plan was to use two different pulses for on and off but then we decided to use a single pulse. The modules check the status of the base and decide whether to send the pulse or not. This was achieved by using a 4 NAND IC inside the Base. This is the design we implemented.

Alternative solution is to use separate links to on and off or to use two different pulses. But we decided our solution is good because NAND IC was not a high cost, and it doesn't consume much power. The drawback of it was the IC is needed for every module.

We generated pulses with a NOR gates. Theoretical pulse width is 1.4ms but it was around 1.8ms when measured. We used QUAD NOR IC and it was possible to make two different pulse generators with it. Some modules needed two independent pulse generators, but some needed one. But we used the same set of ICs for all the modules considering their low cost.

Modules also has their own circuits to achive their designated tasks.

Power Consumption

Base

With Relay on - 330mW

Stand By - 3mW

Wireless Module - 69.6mW

Bluetooth Module - 200mW

We used 3.5W power supple

Development Costs

Expense	Price (Rs.)
PCB Printing PCB - 6	15,000
Enclosure Printing Power Base - 1 Modules - 4	15,000
Electronic Components	15,000
Other Costs Transportation Drill Soldering Iron Other Accessories	10,000
Total	65,000

Budget

Power Base

Component	Price (Rs.)
74HC74 ic (D flip flop)	70
5V single-channel Relay module	75
AC to 5V dc converter	285
4 ports	4 x 30
Enclosure	1500
PCB	1500
3 Pins (Male, Female)For take 230	80
Other	300
Totoal	3940

Timer Module

Component	Price (Rs.)
NE555 ic	30
PCB	1500
Toggle Switch	20
Enclosure	1500
Other	300
Total	3350

HC06 Bluetooth Module

Component	Price (Rs.)
ATmega 328p	1400
HC-06 Bluetooth Module	1200
PCB	1500
Enclosure	1500
Others	300
Total	5900

*we have considered development costs only, actual production costs will be much more lower.

Reprogrammable Timer Module

Component	Price (Rs.)
Timer module	1000
PCB	1500
switches	200
Enclosure	2000
Other	300
Total	5000

Wireless Switch

Component	Price (Rs.)
Wireless transmitter and reciever	1000
PCB	1500
Enclosure	2000
Others	300
Total	4800

*we have considered development costs only, actual production costs will be much more lower.

Maximizing Customer Success

Key Considerations for Marketing, Sales, and After-Sales

Product Packaging

Since the product packaging is the first interaction a customer has with our product, it's important to make it eye-catching and informative while also aligning with our brand identity. We plan to implement the following concepts into our product packaging.

- **Product demonstration:** We will incorporate a product demonstration into the packaging at the back such as a small window explaining the basic functionalities and the steps of setting up the device. Also we will include a product manual inside the packaging as well.
- **Minimalist design:** A sleek, minimalist design with a clean, simple look can convey a sense of modernity and sophistication. We will use a white / blue finish with our logo, product name and the features included at the front.
- **Interactive packaging:** We will incorporate an interactive element into the packaging, such as a QR code that takes the customer to an instructional video that provides further information and instructions for use.
- **Eco-friendly packaging:** As consumers become more environmentally conscious, eco-friendly packaging is becoming increasingly popular. We will Consider using sustainable materials such as recycled cardboard or biodegradable plastics to reduce the impact of your product on the environment.

Marketing

Our main marketing strategy will be Marketing through Industry Partnerships -

By partnering with other companies or organizations in the smart home or tech industry, we can leverage their audience and expertise to increase brand awareness, credibility and reach a wider customer base.

- Attend industry events: Attend industry events such as trade shows, conferences, or workshops to network with potential partners and showcase our product.
- Create joint content: Work with our partners to create joint content such as blog posts, videos, or webinars that showcase the benefits of our products or services.
- Identify potential partners: Identify companies or organizations in the smart home or tech industry that have a similar target audience and complementary products or services. These will be companies that sell smart home devices, home security systems, or home automation services.
- Reach out to potential partners: Reach out to potential partners and explain the benefits of a partnership. For example, we could co-create content, share social media posts, or offer joint promotions or discounts to each other's customers.

Other Marketing strategies -

- Social Media Marketing
- Email Marketing
- Influencer Marketing

Sales Strategy

We will try to sell our product through our partners and distributors so that it will be aligned with our marketing strategy.

- Provide product samples: Provide product samples to potential partners so they can see the quality and functionality of your product first-hand. This can help build credibility and increase the likelihood of them choosing to partner with your company.
- Negotiate terms: Negotiate terms with your partners, such as pricing, distribution agreements, and marketing support. Establish clear expectations and goals upfront to ensure a successful partnership.
- Provide marketing support: Provide marketing support to your partners to help promote your product. This could include providing product information, marketing materials, and training sessions.

After Sales Services

Providing after-sales services can help build customer loyalty and increase customer satisfaction. We will be able to provide the following after sales services for our smart modular power outlet :

- **Technical support:** Offer technical support to customers who are experiencing issues with their smart modular power outlet. This will include troubleshooting advice, repair services, or replacement parts.
- **Warranty services:** Provide warranty services for our smart modular power outlet to give customers peace of mind. This could include a standard warranty that covers defects or malfunctions, or an extended warranty for an additional fee.
- **Customer education:** Provide educational resources to help customers understand how to use and maximize the benefits of their smart modular power outlet.
- **Feedback channels:** Provide channels for customers to provide feedback and suggestions for improving our product. This can help us identify areas for improvement and provide a better customer experience.

Task Allocation

Sanuja

- Enclosure Designing & Printing

Danidu

- PCB Designing & Printing

Dinuka

- PCB Designing & Printing

Mihiran

- Circuit Designing for Power Base & Modules



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Way Ahead

After some arguments we decided to create our own port. We knew it would not be a easy task but we wanted to take the challenge.

The 3D printed port had some contact issues therefore we could not use it because it was not providing stable connections to the modules. We tried a different approach. It was also not promising. Therefore in the demo we had to switch back to an available port.

There was another error in the plug pins too. It was also not contacting properly with the Power Base due to some errors in the dimensions of the printed Base.

First we must correct these technical faults. We are planning on using magnetic port for the connections. We have decided to use already available ports instead of designing our own. We must do some modifications to the design to accompany this.

We believe our circuits are robust enough to go to the next phase. We are planning on using SMD components.

We believe the overall enclosure design is good for the next phase despite some difficulties encountered with the port and the power pins.

Overall we believe our prototype was a success and there is a way ahead.