

## Development of Smart Letter Box (SLB): Engineering Process in Entrepreneurial Product

<sup>1</sup>Mazita Binti Mat Ali and <sup>2</sup>Kamsidi @Abd Malek Bin Sidek

<sup>1</sup>School of Electrical Engineering,

<sup>2</sup>School of Mechanical Engineering,

Polytechnics Sultan Abdul Halim Mu'adzam Shah, 06000, Jitra, Kedah, Malaysia.

**Abstract:** Entrepreneur has become the requirement field that needs a specific attention in the education system. It is a basic element that needed in the human capital development to create job creator. Smart Letter Box (SLB) development is an innovative invention based on the engineering process in entrepreneur education. It makes easier to let the consumer know about the letters received. SLB can be operated at home with 240V power supply. It uses Arduino system that sends the signal to the GSM module that will send a notification to the consumer's telephone number. SLB is a product that facilitates acceptance notification to users. This SLB can operate in a user house using 240V Electricity supply. The SLB has the potential to be introduced in the market especially in Malaysia's domestic housing. SLB can be introduced to the domestic housing market to create job creator application among the engineering students.

**Key words:** Development of New Product, Experimental Design, Job Creator

### INTRODUCTION

In the last few decades, the sudden increasing number of the new product launch, has made engineering industry based on the entrepreneur education more creative and innovative. They also has been more competitive on the need for new product invention among the engineering students with good hands on skills [1].

The mailbox can now be seen throughout the country. In Malaysia, P.O. boxes are often seen in housing and office. This mailbox works for easy postman to place a letter without having to call the host to take a letter, but nowadays a mailbox is very rarely used because users can get easier through time technology now like a short message via mobile phone. The development of new product based on the consumer innovation need to be emphasized in order to sustain the sustainability of the entrepreneur education among the entrepreneurial engineering students.

Also, users do not know whether the mailbox contains a letter or not. The busyness of today's society makes it impossible for them to see the letter in the mailbox,

because it is a rainstorm. Losing a letter will also occur if the user does not see the letter very often. Sometimes the letter arrives is important to the user but due to their busyness the important letter is abandoned and is subject to rain.

Thus many smart letter boxes are produced but it still does not make it easy for users to know whether or not a letter is in their mailbox. So this 'Smart Letter Box' (SLB) has been updated to make it easier for users.

### OBJECTIVE

The creation of SLB is because of the letters received at home were being ignored by the busy house owner. Plus, the notification of the incoming letters or documents into the letterbox will reduce the waiting time of the consumer for re-checking their letterbox.

This system will notify the consumer about the incoming letters by the LED bulbs installed inside the house. This system notifies the consumer via short messaging system (SMS) once the letters inserted into the letterbox.

**Corresponding Author:** Mazita Binti Mat Ali and Kamsidi @Abd Malek Bin Sidek, Polytechnics Sultan Abdul Halim Mu'adzam Shah, 06000, Jitra, Kedah, Malaysia.

This project is introduced in the market especially in the domestic neighborhoods because it uses 240V (single phase) where only one GSM registered owner for each SLB will receive the SMS notification.

**METHODOLOGY**

In this research, the true experimental design was applied in developing the new design based on the researcher observation. Observations have been done through the empirical data from the questionnaire to ensure the consumer demand of the SLB is high. The entrepreneur process happens at the observation phase of the problems faced by the consumer in the receiving letters/parcel scope through letterbox.

SLB is a product that makes it easier to receive letters for the consumers. This system is best use in the neighbourhood with 240V (single phase) and a power supply near to the letterbox. This product is one of a kind, and let the consumer easily know whether there are letters or not inside the letterbox. This product is controlled by the consumer whether they want to receive the SMS or not by replying to the SMS sent by the GSM modem

The design concept of a product is based on several factors to fulfil the standards[3]. The factors in material selection are as follow:

- 1) Material cost (To ensure the product can be commercialized, affordable and concise and easy concept).
- 2) Quality (To ensure the product is high quality as the material used is weather proof (equatorial climate user) and waterproof to avoid damage on the system)

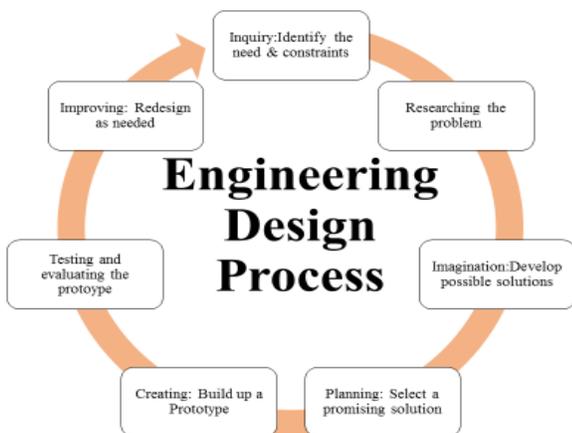


Fig 1: Engineering design process develop a product

**a) Creating Ideas**

In the past, it was created a mailbox intended to be used to connect and communicate with the public through mail delivery. Previously, these papers were made from natural wood, but due to unfavourable weather factors e.g. rain, heat as well as pest disorders such as termites that cause the condition of the mailbox to be easy decomposed and not long lasting. Thus, in modern times nowadays the use of the mailbox has been upgraded with the use of plastic and iron material which has a durable and durable physical condition, but has a disadvantage that is easily stainless and broken due to weather factors.

This mailbox has been heavily sold on the market nowadays, with modifications made to the mailbox that attracts users and makes it easier for the user to know the presence of a P.O. box. An example of modifications made to the mailbox is to change how to use the mailbox, by creating a method of using a light-coded mailbox, which is to alert the user that the letter reached, as well as Use of sound usage using buzzer and speakers to connect between people inside and outside the letter.

For this product, it is a product that makes it easy for people to know if in the mailbox has no ataupum letters. This product is also capable of being controlled by the user whether to receive SMS or not just by replying to SMS sent by the GSM modem.

The collected information will be read and understood to ensure it is related to the project. All the data is gathered and documented systematically and makes it easier to work with.

From time to time, the data will be updated in order to get the information according to the project. The information gathered will act as a reference if the project is not functioning well because of the installation and use of inappropriate formulas. The design concept ensures how a technique can solve the problems arise. Hence, the design arrangement may be quite useful in certain environments, such as a tall apartment building and a long private street, where multiple users are relatively spread out [6]. The goal is to translate the functions or process in the form of requirement specifications to components.

Every process and relationship between processes needs to be explained in details to easily develop the project determining the right design. Design phase determines the right implementation in each project implementation process.

## b) Design Concept

In this process, several design concepts created based on the planned projects. The comparisons are based on [7]:

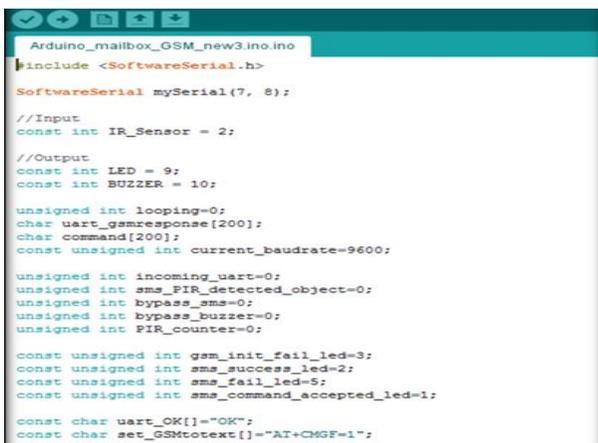
- i. The efficiency of the system used
- ii cost
- iii customer satisfaction

This project is systematic and professional with the system used, the customer satisfaction is ensured. The main component in the development of SLB is IR sensor, GSM Modem, LED, Adaptor, capacitors, and Arduino UNO with its programming language.

Based on observations and studies, there are some important parts of the basic and need to be available for a SLB. The components used are "IR sensor, GSM modem, LED, adaptor, DC Jack.

Infra-Red (IR) detector or sensor is an electronic component that can identify the light of infra-red (infra-red, IR). The Infra-red sensor or red infra detector is currently available activating created in a module and named as IR Detector Photo modules. IR Detector Photo modules are a digital infrared detector in which there is photodiodes and amplifier (amplifier). IR Detector Photo modules used in this robot plan are the type of TSOP (TEMIC Semiconductors Optoelectronics Photo modules). The TSOP has all sorts of options suitable for the frequency of 30 kHz until the 56 kHz.

GSM Modem uses a mobile phone as its data transfer system. This GSM Modem will be used for the entire connection card from any supplier as long as GSM, such as a telecommunication card (or connection card). Figure 2 shows a programming diagram for the GSM module.



```
Arduino_mailbox_GSM_new3.ino.ino
#include <SoftwareSerial.h>
SoftwareSerial mySerial(7, 8);

//Input
const int IR_Sensor = 2;

//Output
const int LED = 9;
const int BUZZER = 10;

unsigned int looping=0;
char uart_gsmresponse[200];
char command[200];
const unsigned int current_baudrate=9600;

unsigned int incoming_uart=0;
unsigned int sms_PIR_detected_object=0;
unsigned int bypass_sms=0;
unsigned int bypass_buzzer=0;
unsigned int PIR_counter=0;

const unsigned int gsm_init_fail_led=3;
const unsigned int sms_success_led=2;
const unsigned int sms_fail_led=5;
const unsigned int sms_command_accepted_led=1;

const char uart_OK[]="OK";
const char set_GSMtotext[]="AT+CMGF=1";
```

Fig 2: Programming Diagram for the GSM

Capacitor is a passive two-terminal electrical component that keeps electric energy at field effects. The Electrical capacitors are known as a seasoning. Although the seasoning exists between any two electrical conductors of a circuit that is near quite close, the capacitors is designed to provide and improve this effect for a wide range of practical applications with regard to size, shape, and position Conductors are close, and the intervention of the material is electrical.

Physical and construction forms of practical capacitors vary widely and the various types of capacitors are often used. Most of the capacitors contain at least two electrical conductors often in the form of metal plates or surfaces separated by electrical substances. Non-conducting act to increase capacitors charge capacity. Commonly used materials include glass, ceramic, plastic film, paper, Mika, and oxide layers. Capacitor is widely used as part of an electrical circuit in various ordinary electrical devices. Unlike the barrier, the capacitors ideal does not lose energy.

## RESULTS AND DISCUSSION

The outcome of this project can achieve the needed early objective. The goal of SLB is to ease the consumer in knowing the letters in letterbox. The consumer will receive an SMS on the inserting of the letters into the letterbox. The consumer will receive an SMS notification about the letters when inserted into the letterbox.

In Figure 3, written instruction of Arduino programming [5] will instruct IR sensor to trace the letters, then, the consumer will receive GSM which sending an SMS telling about the letters to the registered consumer. The consumer will receive just one SMS even though the letters inserted are more than one at one time.

Arduino UNO is a Microcontroller board full of ATmega328. Arduino UNO has 14 digital input/output (6 in between them can be used as PWM output), 6 analog inputs, an 16 MHz crystal oscillators, a USB, an power jack, a ICSP header, and a reset.

Arduino UNO takes everything needed for a microcontroller, easy to connect it to a computer with a USB cable or an icon with an adaptor AC to DC or use battery to return it.

Adaptor is a network that is used to transform the high tensile (AC) into a low DC. While the power of the DC drain the voltage of 12V and manufactures its current 2A. It has an jack of DC. The adaptor works well with

12V applications. This Adaptor is important to provide power supply to turn the system on Arduino because it is a major play.

```

Arduino_mailbox_GSM_new3.ino
char uart_gsmresponse[200];
char command[200];
const unsigned int current_baudrate=9600;

unsigned int incoming_uart=0;
unsigned int sms_PIR_detected_object=0;
unsigned int bypass_sms=0;
unsigned int bypass_buzzer=0;
unsigned int PIR_counter=0;

const unsigned int gsm_init_fail_led=3;
const unsigned int sms_success_led=2;
const unsigned int sms_fail_led=5;
const unsigned int sms_command_accepted_led=1;

const char uart_OK[]="OK";
const char set_GSMtotext[]="AT+CMGF=1";
char read_sms_command[]="AT+CMGR=10";
char delete_sms_command[]="AT+CMGD=10";

const char new_sms_indicator[]="+CMTI: \\'SM\\',";
const char first_recipient_phone_number[]="AT+CMGS=\\"0194607728\\"";
//const char second_recipient_phone_number[]="AT+CMGS=\\"0195280028\\"";
const char received_sms_text[]="Text";
const char received_sms_sms_off[]="SMS off";
const char received_sms_sms_on[]="SMS on";
const char reset_PIR_counter[]="Reset counter";
const char sent_sms_text_object_detected[]="Anda mempunyai surat di peti surat anda.";

void setup()
{
  pinMode(LED, OUTPUT);
  pinMode(BUZZER, OUTPUT);
  digitalWrite(LED, LOW);
  digitalWrite(BUZZER, LOW);

  //Setup uart
  mySerial.begin(current_baudrate); // Setting the baud rate of GSM Module
  Serial.begin(current_baudrate); // Setting the baud rate of Serial Monitor (Arduino)
  delay(100);

  Serial.println("Trying to Communicate with GSM Module...");
  while (memcmp("OK",uart_gsmresponse, 2) != 0)
  {
    gsm_send_command("AT");
    gsm_read_line();
    delay(2);
    Serial.print(uart_gsmresponse);
  }
  Serial.println("GSM Module Communicated Successfully.");
  memset(uart_gsmresponse, '\\0',200);
  // Set text mode for SMS
  Serial.println("Trying to set GSM Module to text mode...");

  while (memcmp("OK",uart_gsmresponse, 2) != 0)
  {
    gsm_send_command(set_GSMtotext);
    gsm_read_line();
    delay(2);
    Serial.print(uart_gsmresponse);
  }
}
    
```

Fig 3: Arduino Programming

SIM 900 GSM/GPRS Shield is a functional tool to do communication between mobile phones with Arduino using the GSM network. Using this tool, we can send and receive SMS and calls, using general purpose input/output (GPIO) provided. SIM900 uses AT Command to operate and use UART Communications (Universal Asynchronous Receiver/Transmitter) with Arduino. SIM900 owns 12 GPIO, 2 ADC and 1 PWM.

SIM900 can operate in Quad Band, which is an animated GSM network of 850MHz, 900MHz, a Dual-Band of 900/1800MHz. Figure 4 shows the design of GSM circuits used in SLB.

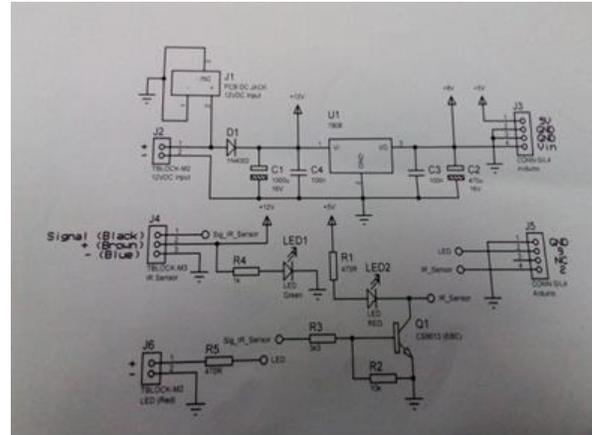


Fig 4: Design of GSM Circuits

The use of "IR SENSOR" is one of the most important components to detect letters that are inserted into the mailbox. IR SENSORS must be moved with 3-5V to function. The most appropriate 5V power provider used is the microcontroller Arduino. Unlike Photocells and FSRs where they behave like a barrier and therefore can only be tested with Multimetre. Figure 5 shows a circuit of IR sensors used in SLB.

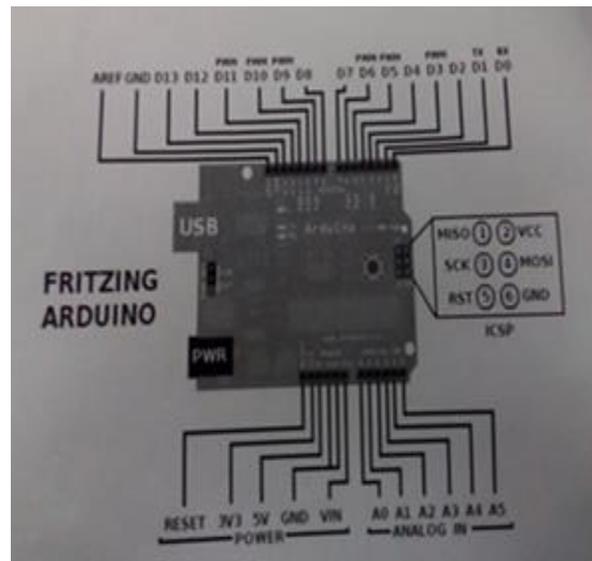


Fig 5: Circuit of IR Sensors

For the wire connection ensure that Pin 1 is a output for light LED and barrier, while Pin 2 is the land, Pin 3 is the VCC connected to 3-5V. When the detector sees the IR signal, it will draw low output to turn LED. The red color is more used as a warning sign or notification about a signal. So the use of red LED is more suitable for use as IR sensor output.

The following is the installation of components used for the flame LED system as shown in Figure 6.



Fig 6: Installation Components for The Flame LED

Figure 7 shows the construction diagram and assembly of circuits for the SLB system.

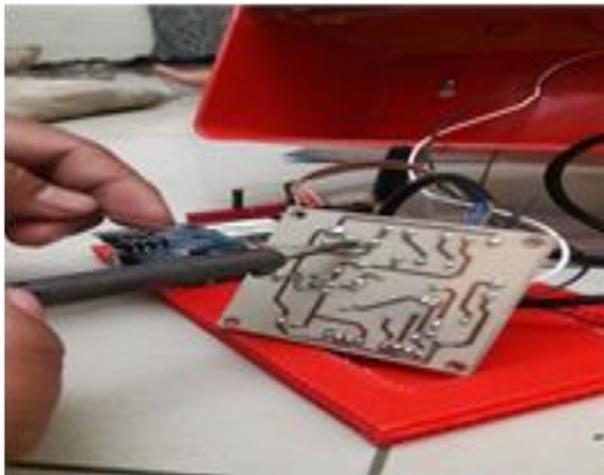


Fig 7: Construction Diagram and Assembly of Circuits

The LED has a maximum advanced mainstream (Forward Current) of low enough to the set of LED, we have to place a Resistor that serves as a top-up for the current drain that flows to LED not exceeding the maximum limit of the leading pace itself. Otherwise, the LED will be easy to burn and damage. Most advanced mainstream (Forward Current).

The maximum of a LED is around 25mA until 30mA depends on the type and color. The following is the maximum advanced mainstream sortable and the advanced tensile for each type and color LED in generally (rounded LED with 5mm diameter). This LED is used as a signal.

In Figure 8, it shows the interior of SLB. The clean and tidy installation makes the letters easier to be

inserted. The system can function very well and efficiently.



Fig 8: Interior Smart letter Box

The low cost that attracts consumer to buy this device because it is important to simplify the consumers' daily routine with those who don't have time to always check into the letterbox.

The quality of material used by the researcher is also very good and cheap and durable. Figure 9 shows the application of SLB installation at a consumer's house. It looks simple and spacious.



Fig 9: Applications of smart letter box

## CONCLUSION

As a conclusion of the SLB project was implemented, reviewed and successfully completed to meet the objectives of the study. It works using components – electronic components such as LED, GSM (Global System For Mobile Communications, Infrared sensors, Programming, and control switches

appropriate to turn on and off the system. It uses a letter delivery concept with short messaging Service (SMS) through mobile phone to users.

The SLB also uses Arduino Uno for programming. Through these SLB designs, there are many skills needed mainly from the corner of Mechanical, electrical and programming designs. The SLB design has achieved the main objective that the system is able to inform the consumers of the presence of letters in the P.O. Box with a LED signal-mounted, and receive notification through the SMS to users who have registered their phone number.

From this study, this project gives a high impact to the researcher especially the students carrying out the entrepreneurial duties, as we know, an entrepreneur is someone that create, market, and sell the products[4]. So, that impact will create job creator among young researchers especially engineering students.

The researcher suggests, in the future, the usage of SLB is compulsory for everyone in order to fulfil the needs of current technology. It is also hoped to create awareness to other researchers to use engineering technology in creating products that suit to the consumers' wants.

The researcher also hope that the university or TVET institutions can create a creative and innovative entrepreneur program that related to products invention to create job creator people among the students to the community in the worldwide.

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