Volume 5, Issue 11, November 2015 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Advanced Locking System

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Abstract— Everyone is concerned with security. Everyone wants security in his/her house, office and in other places. Everybody wants themselves to keep safe or secure from various incidents like theft in their house or office.This Advanced Locking System is a locking technology where traditional key is replaced by modern GSM technology. Traditional lock and key system has several flaws like if key has been lost then user feels insecure, key can easily be copied, even as locking technique is known to almost everyone it can easily be cracked. To reduce vulnerability and to make the system robust this lock has been developed. It allows a user to program a "string"(digital key) that will unlock the lock and there will be another code for locking the device. As this code is known only by owner and some persons selected by the owner there is a very lesser probability to unlock the code by any unauthorized person. This is a module based on microcontroller and a GSM 300 kit. It can be remotely controlled by the owner. The user who wants to unlock the lock will first send the string(digital key) to a particular GSM SIM number through a sms from user's mobile. If the digital key of sms will get matched with the digital key which has already been programmed in the device then only lock will unlock. In the same way if the user who wants to lock the lock will first send the string(digital key) to a particular GSM SIM number through a sms from user's mobile. If the digital key of sms will get matched with the digital key which has already been programmed in the device then only lock will get locked. Again if owner is far from his home and he wants to unlock the door for someone then he can remotely unlock the door without informing him the secret digital key. Each time user either locks or unlocks the door, the owner or administrator will be notified. If anyone rather than owner sends a SMS to device to unlock the system, then owner will be notified that someone is trying to unlock or lock the system. If owner authenticates user to operate the system then only user can operate it else not.

Keywords— Microcontroller, Arduino UNO, GSM SIM 300, User authentication.

I. INTRODUCTION

This project has 2 parts one GSM SIM 300 to receive the digital key from user and another part is Arduino UNO microcontroller to decode the digital key and to instruct the system to follow the instruction. There is one input for the GSM Based Smart Locker. The input is SMS which has to be sent to GSM 300 module to lock and unlock the locker. There are 2 LEDs also, green LED and red. If the door is closed the red LED turns on and if it gets unlocked the green LED turn on. Output of this project is locking and unlocking [servo motor[1] + status LEDs] and EXECUTED acknowledgement to user after execution. Owner of the system will also receive notification about user's mobile number and command SMS sent by the user. If someone else than owner sends sms to system to control it he/she has to be authenticated by the owner first.

II. IMPLEMENTATION

Traditional lock and key has so many security issues so our trend is towards electronic lock. To remotely operate the lock we usually like GSM based system. There is another problem that anyone can operate it if he/she knows the SIM card number which has been installed into the system. This project is based on microcontroller and GSM SIM 300. Here we have used Arduino UNO to make this system reliable and robust. GSM 300 kit has been used for authentication purpose and remotely controlling the system. And above all user authentication is present here. Here is the details of implementation.

The GSM Based Smart Locker is implemented on a miniature locker replica, with a locker-frame and a door that can be opened and closed. There is also a bar that comes down in front of the door, not allowing it to be opened, which simulates our lock. We will finally install the LEDs on the top of the doorframe to be visible and accessible by the user. The breadboard, GSM SIM 300 and Arduino are mounted just inside the doorframe.

A. Software

The code for the system is all written in the Arduino[2] programming environment. The software is used for many of the background processes such as:

- Storing the digital key first to Arduino UNO through programming on it for lock and unlock
- Comparing the sender's number with owner's number
- If user is not owner then he/she has to be authenticated by the owner and then only he/she can operate it
- Comparing SMS with digital key
- Detecting the state of the system
- Unlocking the door
- Locking the door
- Determining if the door is opened or closed
- Determining if the door should be locked or unlocked
- Lighting up LEDs

The Arduino integrated development environment (IDR) is a cross-platform application written in Java, and derives from the IDR for the language and the Wiring projects. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. A program or code written for Arduino is called a sketch. Arduino programs are written is C or C++. The Arduino IDE comes with a software library called "Wiring" from the original Wiring project, which makes many common input/output operations much easier. Users only need define two functions to make a runnable cyclic executive program:

- Setup(): a function run once at the start of a program that can initialize setting.
- Loop(): a function called repeatedly until the board powers off.

B. Hardware

Arduino -> The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Arduino is a single-board microcontroller, intended to make building interactive objects or environments more accessible. It is a tool for making computers that can sense and control more of the physical world than our desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Relay Driver -> Relays have been around for a long time and though often now replaced with solid state switches, they have unique properties that make them more robust than solid-state devices and are not going away. The unique properties are high current capacity, ability to withstand ESD and drive circuit isolation. There are numerous ways to drive relays. In preparation for some of the more advanced relay drivers I will be posting in the future, I have listed a few basic relay drivers for our reference. Included are the following: High side toggle switch driver, low side toggle switch driver, bipolar NPN transistor driver, Darlington transistor driver, N-Channel MOSFET driver, and ULN2003 driver.

Power Supply-> It will take 12v Battery as a power supply to activate the Arduino uno.

Motorized Lock -> Motorized lock installed inside metal doors providing multi-bolt locking. It is Suitable for installation in new or existing metal doors with a multi-point locking mechanism. It is recommended for installation in Internal and external doors in public buildings, institutes and offices, such as - main entrance doors, safety doors with access control, fire doors, emergency and automatic doors.

GSM SIM 300 ->It is a plug and play GSM Modem with a simple to interface serial interface. Use it to send SMS, make and receive calls, and do other GSM operations by controlling it through simple AT commands from micro controllers and computers. It uses the highly popular SIM300 module for all its operations. It comes with a standard RS232 interface which can be used to easily interface the modem to micro controllers and computers.

III. HARDWARE EQUIPMENT

A. Arduino UNO

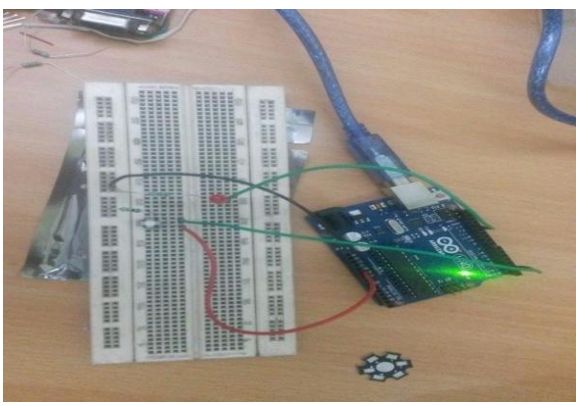

Fig. 1ARDUINO UNO connected with Breadboard

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.
The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

TABLE I. TECHNICAL SPECIFICATION

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

.

B. Resistor

Resistors are electronic components which have a specific, never-changing electrical resistance. The resistor's resistance limits the flow of electrons through a circuit.
They are passive components, meaning they only consume power (and can't generate it). Resistors are usually added to circuits where they complement active components like op-amps, microcontrollers, and other integrated circuits. Commonly resistors are used to limit current, divide voltages, and pull-up I/O lines. A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors act to reduce current flow, and, at the same time, act to lower voltage levels within circuits. It is measured by OHM.

C. LED

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a pn-junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor.

D. Electro-Magnetic Lock

Fig. 2 Electromagnetic lock

An electromagnetic lock[3], magnetic lock, or maglock is a locking device that consists of an electromagnet and an armature plate. There are two main types of electric locking devices. Locking devices can be either "fail safe" or "fail secure". A fail-secure locking device remains locked when power is lost. Fail-safe locking devices are unlocked when de-energized. Direct pull electromagnetic locks are inherently fail-safe. Typically the electromagnet portion of the lock is attached to the door frame and a mating armature plate is attached to the door. The two components are in contact when the door is closed. When the electromagnet is energized, a current passing through the electromagnet creates a magnetic flux that causes the armature plate to attract to the electromagnet, creating a locking action. Because the mating area of the electromagnet and armature is relatively large, the force created by the magnetic flux is strong enough to keep the door locked even under stress.

E. Lock Driver Circuit

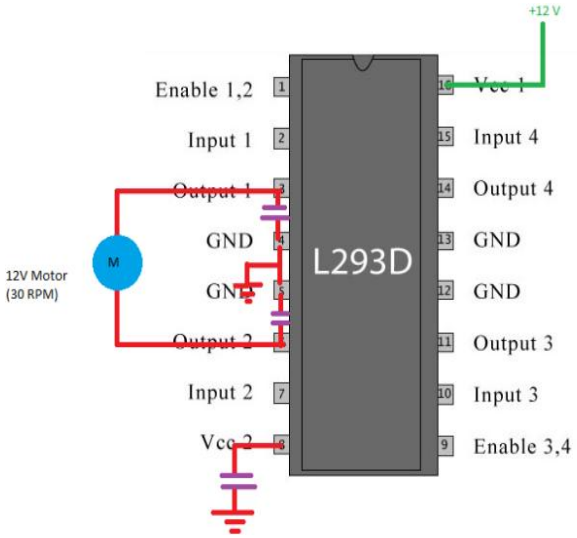

Fig. 3 Driver circuit

A driver circuit is needed to drive the electromagnetic lock. The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply application.

F. GSM SIM 300

Fig. 4 GSM SIM 300

A GSM Modem is a device that modulates and demodulates the GSM signals and in this particular case 2G signals. The modem we are using is SIMCOM SIM300. It is a Tri-band GSM/GPRS Modem as it can detect and operate at three frequencies (EGSM 900 MHz, DCS 1800 MHz and PCS1900 Mhz). Default operating frequencies are EGSM 900MHz and DCS 1800MHz.

Sim300[4] GSM module used here, consists of a TTL interface and an RS232 interface. The TTL interface allows us to directly interface with a microcontroller while the RS232 interface includes a MAX232 IC to enable communication with the PC. It also consists of a buzzer, antenna and SIM slot. Sim300 in this application is used as a DCE (Data Circuit-terminating Equipment) and PC as a DTE (Data Terminal Equipment).

IV. FLOWCHART AND DFD

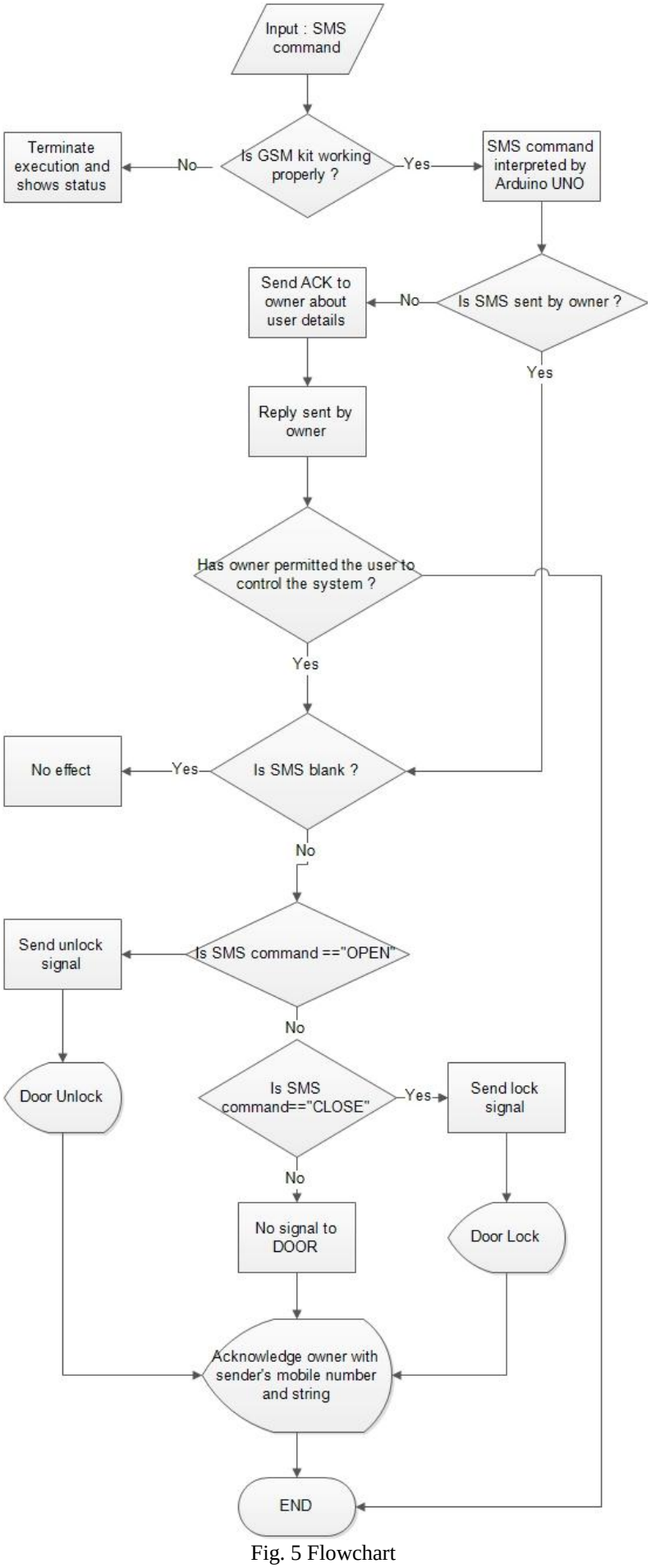

Fig. 5 Flowchart

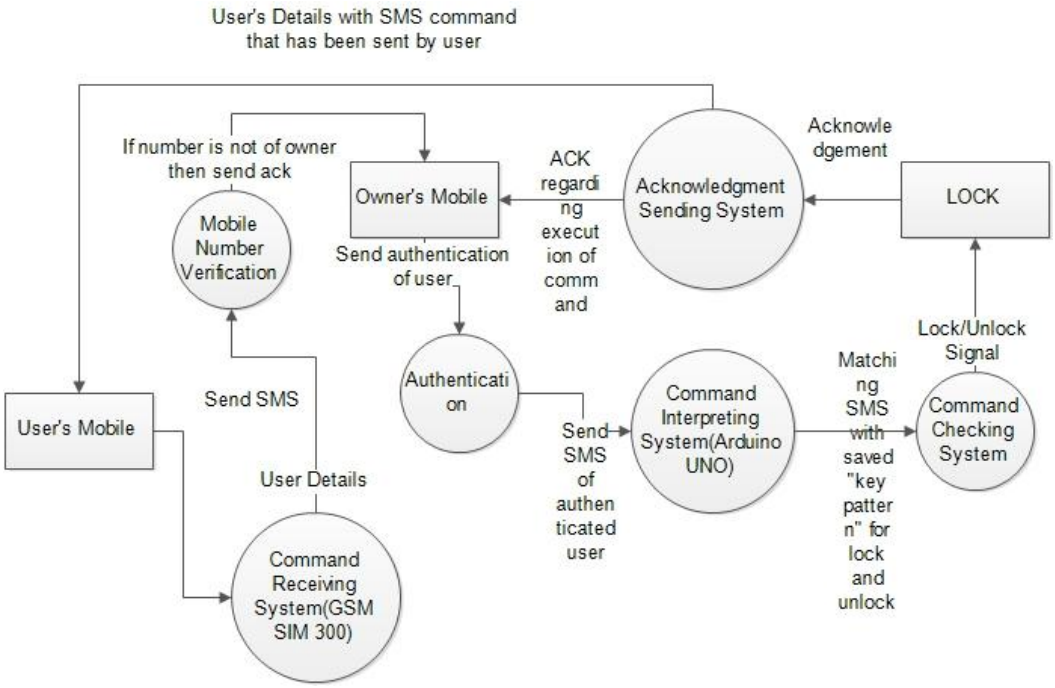

Fig. 6 DFD

V. BLOCK DIAGRAM AND CIRCUIT DIAGRAM

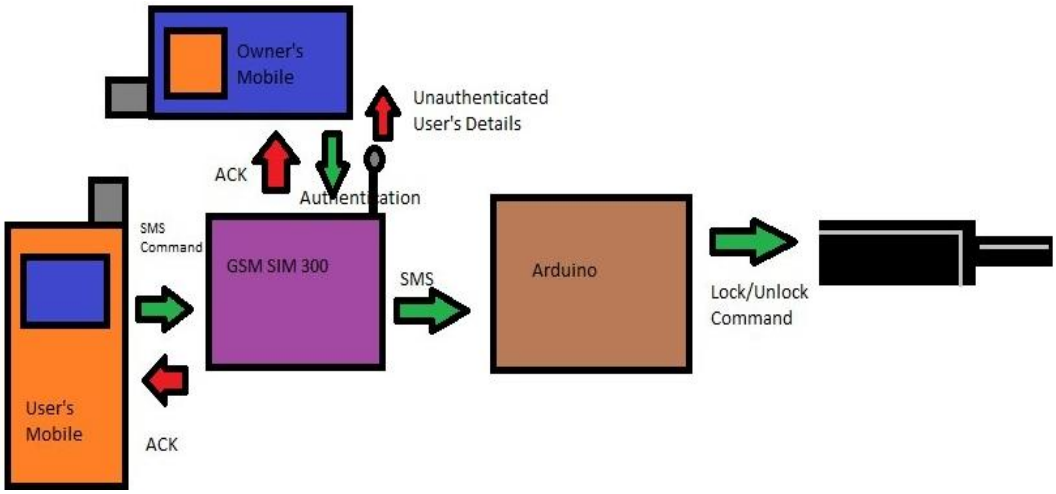

Fig. 7 Block Diagram

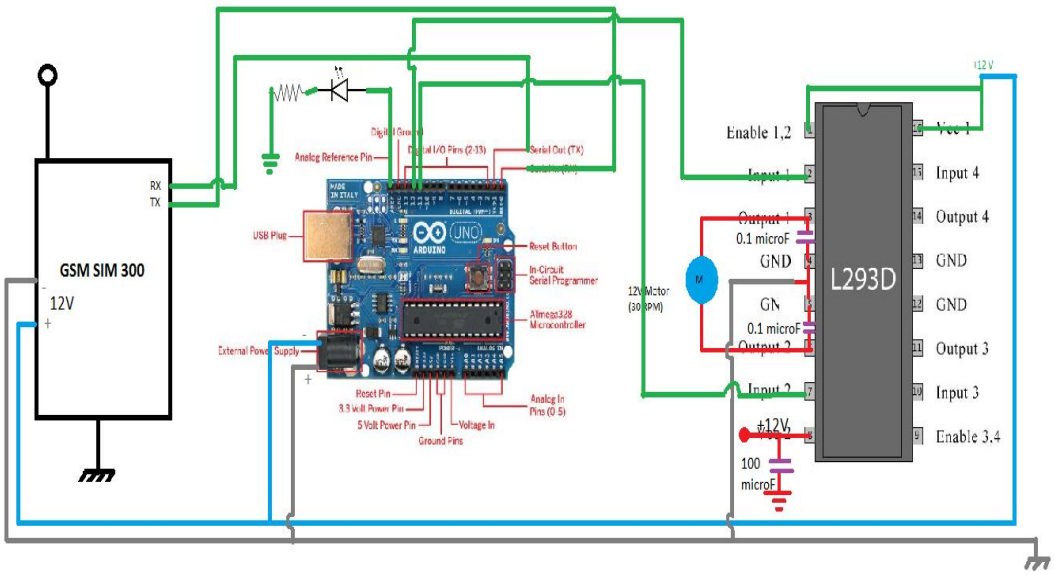

Fig. 8 Circuit Diagram

VI. ALGORITHM

```
intauth=0,n=0;
String users[10],temp="",temp1="";
setup() :-
pinMode(13,OUTPUT);
Serial.begin(9600);
pinMode(13,OUTPUT);
digitalWrite(13,LOW);
delay(2000);
Serial.println("AT");
delay(2000);
if(Serial.readString().indexOf("OK")== -1)
{
digitalWrite(13,HIGH);// idicating GSM fail
delay(2000);
}
Serial.println("AT+CMGF=1");
delay(2000);
Serial.println("AT+CLIP=1");
pinMode(11,OUTPUT);
pinMode(12,OUTPUT);
loop():-
if(Serial.available()>0)
{
GSM_exe();
}
GSM_exe():-
if((gsm.indexOf("+CMTI: \"SM\"")+1))
{
intstr=gsm.indexOf("SM\"")+4;
int en=gsm.indexOf('\n',5);
String st=gsm.substring(str,en);
Serial.println("AT+CMGR="+st);
gsm=Serial.readString();
str=gsm.indexOf(",")+2;
en=gsm.indexOf('\"',str);
String sndr=gsm.substring(str,en);//sender of the msg received by ARDUINO
str=gsm.lastIndexOf('\"')+3;
en=gsm.indexOf("OK")-3;
String msg=gsm.substring(str,en);
Serial.println("AT+CMGD="+st); //deletes sms
//Authentication
if(sndr=='owner')
auth=1;
else
auth=0;
if (sndr='owner' &&msg=='YES'){
auth=1;
addUser(temp);
sndr=temp;
msg=temp1;
}
execute(String);
if (auth==0)
chkAuthentication(sndr,msg);
if (auth==1) {
execute (msg);
SMSsender(sndr,"EXECUTED");
SMSsender("+917278141453",sndr+"\n"+msg); // Number of owner
auth=0;
temp="";
temp1="";
}
```



```
//user defined
execute(String s):-
if((s.indexOf("OPEN")+1)){
digitalWrite(11,HIGH);
delay(1000);
digitalWrite(11,LOW);
}
if((s.indexOf("CLOSE")+1)) {
digitalWrite(12,HIGH);
delay(1000);
digitalWrite(12,LOW);
}
/*
SMSsender(String n, String txt) sends a text msg to 'n' containing text 'txt'
*/
voidSMSsender(String n, String txt):-
Serial.println("AT+CMGS=\""+n+"\"");
while(Serial.read()!='>');
Serial.print(txt);
Serial.write(0x1A);
Serial.write(0x0D);
Serial.write(0x0A);
chkAuthentication(String sndr, String msg):-
for(inti=0; i<n; i++) {
if(sndr==users[i]{
auth=1;
return;
}
temp=sndr;
temp1=msg;
SMSsender("owner","Askauthmsg");
}
addUser(String sndr):-
users[n]=sndr;
n++;
```

VII. SNAPSHOTS

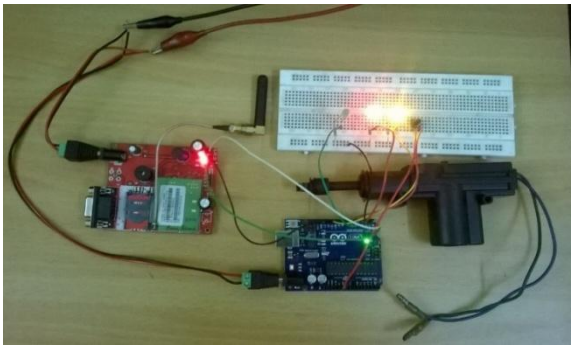

Fig. 9 Snapshot-1

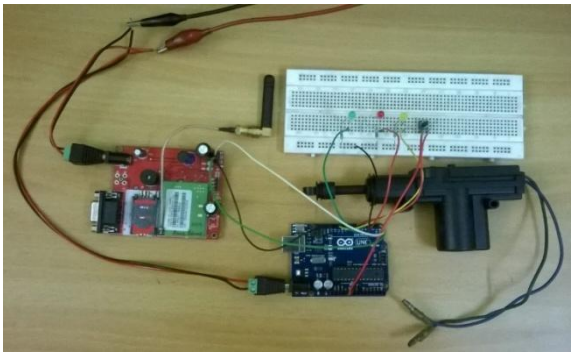

Fig. 10 Snapshot-2

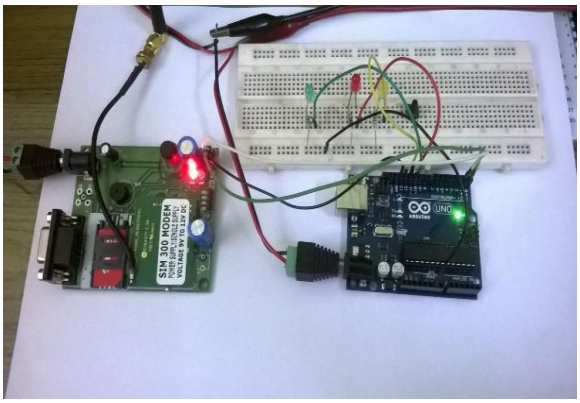

Fig. 11 Snapshot-3

Fig -12: Snapshot of final working model

Fig -13: Snapshot of final working model

VIII. CONCLUSIONS

Our project has several advantages, such as:

- No need to keep key for a particular lock.
- Cost efficient than other high-end lock.
- Low operating cost.
- Locking technique is unique.
- Satisfiable quality and lesser maintenance.
- Remotely controlled.
- GSM based authentication.

Notification will be sent to owner's mobile as well as user's mobile.

ACKNOWLEDGMENT

We would like to thank the institutions: The Heritage Academy and University of Calcutta for providing us the opportunity to develop this project.

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[4] http://www.engineersgarage.com/contribution/how-to-interface-GSM-SIM-300-modem-with-atmega32-to-send-and-receive-SMS

