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Smart Door Lock and Lighting System using Internet of Things

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***Abstract*— In the proposed approach, a smart door lock and lighting system using IoT for smart home is presented. A smart door lock system is a system which uses digital password for opening and closing the door. The door lock is the foremost and endmost thing people come across in entering and leaving the home respectively, the home automation function in digital door lock system allows users to comfortably control and monitor home environment and situation all at once. It also allows users to remotely overlook the situation inside the house through World wide web or any other public network. A smart lighting is proposed which can be remotely controlled using Internet.**

Keywords—Digital door lock system; home automation; GPRS; Sensor node

I. INTRODUCTION

Nowadays, technology is an integral part of everyone's lives. It influences several facets of everyday life and allows improved social synergy, easy transportation, the capability of indulging in entertainment and media and helps in the advancement in medicine. The invention of several devices like cell phones and computers has made several people reliant on technology for interacting with friends, store and retrieve information like images, videos, documents, and music. The world wide web is a common interface that several devices use in order to make the daily life of many people. Internet has played a pioneering role in providing immediate solutions for various problems and has given the ability and has connected all the remote places which has contributed to significant reduction in cost and also energy consumption. Home automation or intelligent home is defined as initiation of technology inside the home surroundings to provide ease and safety to its inhabitants. The technology of the Internet of Things is used to examine and execute home automation.

GPRS, GSM, Bluetooth, Wi-Fi and cellular networks support remote data transferring and are used to enter abundant levels of acumen within the home. Home automation has the ability to greatly assist and improve the quality of life of older people. IoT also greatly contributes to supply management and observance with ease of control. The World wide web is greatly used in home automation that gives decisions via conservative use of energy. The user can remotely control the gate, home appliances, etc comfortably and conveniently anywhere and anytime. [2]. This paper presents an application of IoT used in smart door lock and lighting systems.

II. INTERNET OF THINGS

The Internet of things (IoT) is known as connecting objects like cell phones, personal computer and other devices to the world wide web, which introduces a new era in the area of communication, where objects communicate with each other without human intervention. The establishment of IoT has led to increased research in the area of IoT and development of home automation is becoming really famous nowadays. Most of the equipments and gadgets are controlled and monitored to help and assist humans. Moreover, various wireless technologies assist in communicating with remote places which play a great role in the intelligence of house surroundings. IoT is a sophisticated network of nodes with the unique ability of exchanging data and knowledge wirelessly which enables communication between two objects thereby making them smart and removing the need of humans for machine to machine communication.

III. LITERATURE SURVEY

Authors in [2] propose a smart home using Internet of Things application that is a combination of portable devices, cloud computing, wireless sensor nodes that allows the user to control appliances within the house like lights, fans, door locks etc

Nikhil Agarwal et.al, propose a novel automated Home Security System [3]. The door lock uses a LED based resistive screen input panel which makes the door lock password protected in which the photo diode captures the difference in light intensity which is released by neighboring red LEDs and is reflected by the finger.

In [4], authors present a smart home automation and security system based on field programmable gate array (FPGA) The user can control and monitor the home appliances like air conditioners, lights, door locks etc are remotely controlled via a web page.

Basma M. Mohammad et.al, propose a novel design for the smart home automation using the wireless communication networks and biometric technologies [5]. The proposed system improves the security of existing homes by providing biometric authentification for the home entrance which makes the home entering process for legitimate users easy.

Pavithra.D et.al, proposes a internet of things application for home automation system for controlling home devices through Smartphones with Rasberry Pi in which Wi-Fi is used as a communication protocol[6]. Home appliances like lights, fan and door lock are easily and remotely controlled and monitored using a webpage. The server which is connected to the appliances through relay hardware circuits allows the user to access the various appliances.

Mohannad Ibrahim et.al, propose a novel way to build a economical environmental monitoring device using raspberry pi [7]. Environmental information such as temperature, humidity, light intensity and concentration of carbon monoxide is taken through sensors and uploaded to the internet where it can be accessed anywhere and anytime. It can also detect tectonic disturbances like earthquakes with the help seismic sensors.

Robert R et.al, propose a novel way to implement internet of things applications in the Smart City concept [8] using networks of sensors, wireless nodes and cloud server.

Yan Wenbo et.al, present a novel design of a smart home system [9] and the concept of smart unit and home proxy is introduced in which XMPP is used. The home proxy is combined with remote server which behaves like a service provider and gives service for various homes and work spaces.

Ala Al-Fuqaha et.al, presents a summary of key IoT challenges and provides a summary of related research work between IoT [10] and other upcoming technologies like big data

analytics and fog and cloud computing. The paper works on upcoming developments in RFID, smart sensors, IoT nodes communication technologies and Internet protocols.

Jun Wei Chuah et. al, discuss new perspectives in systems design under IoT [11] covering the following important areas: IoT enablers, existing and novel IoT applications, and current challenges in IoT. The paper defines the IoT foundation on which the future research can be built upon.

Gerfried Cebrat et.al, proposes an IoT application which uses an embedded programmable logic controller [12] to control heating, air conditioning and ventilation in home. Also a home security system is designed which maintains the integrity of user data. Kai Zhao, Lina Ge et.al, presents various security issues in IoT that are present in three layer structure are explored, and solutions are presented. The safety measures concerned with perception layer is elaborated, along with details of key management and algorithm, security routing protocol [13] and data fusion.

Andrea Zanella et.al, proposes a urban smart city system in which advanced communication technologies are used to support value-added services for the administration of the city and for its citizens. This paper has been implemented in the Padova Smart City project Italy in collaboration with the city municipality.

Li Da Xu, Wu He, This paper presents the recent research in IoT, its important enabling technologies, main IoT applications in industries and describes the IoT [15] technologies currently used in industries briefly.

In [16], authors discuss important findings, technological problems as well as socio-economic opportunities in Smart City era. Majority of the deductions are collected during Smart Santander project, an EU project that is developing a city-scale test-bed for IoT and Future Internet experimentation, providing a framework for implementation of Smart City services.

In [17], authors discuss two machine learning algorithms which are used to control household appliances. The system has machine learning capabilities in which a central controller uses the feedback information from household devices to find out the user's habits. The new system is more user friendly and overcomes the poor adaptability and portability defects of the smart home automation systems. In this system the nodes use PLC (Power Line Carrier) modules to interact with each other.

IV. Proposed System

A. *Main features of the proposed system*

The objective of this work is to provide remote access to door lock and lighting system. The obvious motivation for providing such a kind of remote access to door lock is to make homes much more secure and enable us to remotely unlock or lock door for guests etc. This work also ensures that the user need not worry about whether the door is left unlocked or not and hence ensures peace of mind for the user.

The remote lighting system allows user to remotely control lighting i.e. switching it ON / OFF and also vary the intensity of light. This ensures that electricity is never wasted even if the user forgets to switch off the lighting as it can be remotely switched OFF.

B. *Overall structure of the proposed system*

The following figure shows the block diagram of proposed system which controls the door locking and lighting system for the smart home using Internet of Things .The block diagram consists of a GPRS module ,relays, a Microcontroller which is the heart of our proposed system, a LCD display and a keypad.

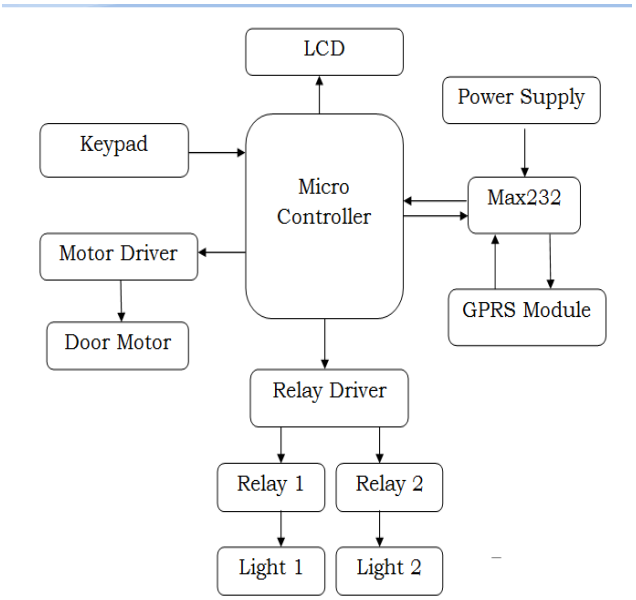

Fig. 1. Block diagram of proposed work

For the proposed system, PIC MC is used as controller. As shown in the figure it is interfaced with a LCD, Keypad, MAX232, Motor Driver and Relay Driver, GSM/GPRS. The keypad is interfaced for the user to enter the password. Also the LCD is interfaced to display the password and other visual details such as password correct/incorrect. When user enters password from keypad then if the password is correct the door is opened. The light or any devices are connected with relay in home.

When user enters password from keypad then if the password is correct the door is opened. The light or any devices are connected with relay in home. If the user wants to switch ON/Off the plug device from anywhere the user can use the internet and type the IP address and then the web page of device control is opened on smart phone, laptop etc. Through GPRS the data is received in the system at home.

The following flowchart shown in Figure 2 describes the algorithm of the proposed system:-

The microcontroller the system checks input data and accordingly it switches ON or OFF the device. All these parameter values are looked upon via the application interface of IoT. The MAX232 which is interfaced to the GPRS Module converts parallel data received through Internet into serial data and sends it to the microcontroller. The MAX232 is used as the microcontroller only works on serial data. The PIC microcontroller provides a current of 2mA which is not sufficient to drive the motor. Hence a motor driver is interfaced to the microcontroller to amplify the current and drive the motor.

The keypad is interfaced for the user to enter the password. Also the LCD is interfaced to display the password and other visual details such as password correct/incorrect. Relays allow a low-power circuit to switch a relatively high current on and off and to manipulate signals that should be isolated electrically from the controlling circuit. For making a relay work, an apt 'pull-in' and 'holding' current are passed (DC) through the energizing coil.

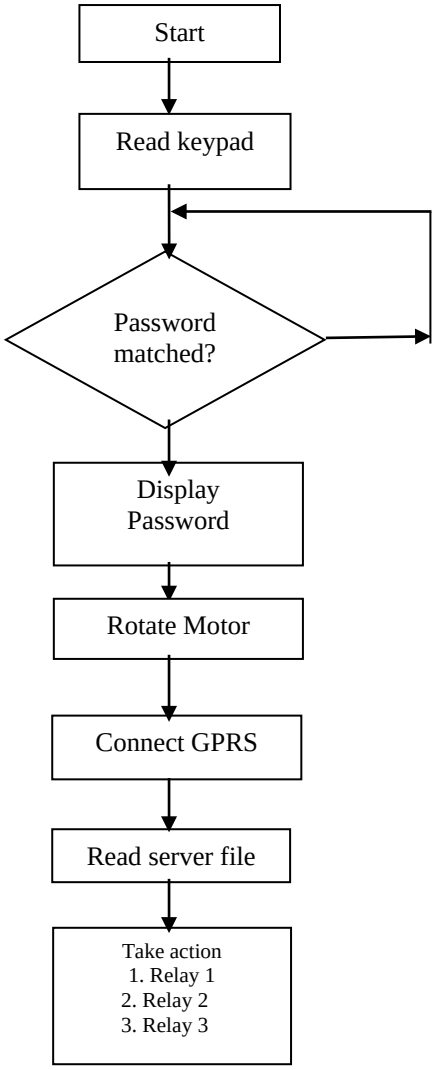

Fig.2. Flowchart of proposed work

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Relay coils are designed to work on a particular supply voltage of 12V or 5V, especially smaller relays. The coil has a resistance which draws the appropriate pull-in and holding currents when connected to supply voltage. Thus the idea is to select a relay with a coil made and designed to work on the supply voltage we use for our control circuit (and having contacts capable of switching the currents that need to be controlled), and then have a suitable relay driver circuit so that the low-power circuitry can manipulate the current via the relay coil. This is between 25mA and 70mA.

The relay is used to lock or unlock the door and to switch ON/OFF the lighting. The MAX232 is a hardware layer protocol converter. The driver converts TTL and CMOS voltage levels to TIA/EIA-232-E levels, which are compatible for serial port communications. The receiver performs the reverse conversion.

Most microcontrollers work at low voltages and PIC16F which is used operates at 5V and require a small value of current to work whereas the motors need a higher voltage and current . Thus current cannot be given to the DC motor from the microcontroller. This is the primary need for the motor driver IC. Hence we have interfaced a motor driver to microcontroller. The motor will be used to operate the hardware mechanism for locking and unlocking the door. A GSM/GPRS module assembles a GSM/GPRS modem with communication interfaces that are standard such as RS-232 (Serial Port), USB etc., so that it can be easily interfaced with microcontroller based system. The power supply circuit is built in the module and can be activated. The module consists of two UARTS, an SPI interface, and also two 10-bit ADCs. It also supports a 4x6 keypad, and a LCD interface. Inputs/outputs are available for a speaker and microphone. An antenna does come attached to the module. A GPRS module is used to send data, messages over a network. The GPRS module is used for sending and receiving the password over the network.

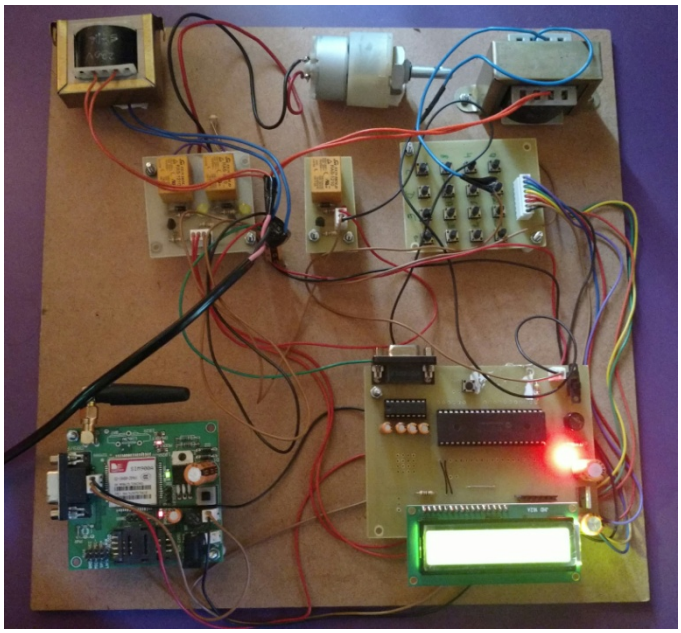

Fig.3. A prototype of the proposed system

CONCLUSION

In this paper, a smart door lock and lighting system is presented which is a novel home automation system using IOT which includes the home security along. The smart door lock and lighting system provide a convenient way to remotely control the door lock and lighting of a house thereby enhancing security and enabling the user to save electricity. It is a low cost, flexible, and a very easy to install system with no overhead like careful planning, cabling, and construction works.

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