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# Design and Construction of Bluetooth Based Caller System in Elevators

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## *Abstract*
Buildings comprising of several floors requires a lot of energy to climb the staircases. The quest to solve the problem in the use of staircase led to the exploitation of the use of elevators. This elevator has so many risks involved in it use; hence, there is need to develop a system that can take care of the emergency in case of faults occurring at different floors of the building regarding the use of the elevators. Also, there is need to demonstrate the used of Bluetooth technology in in the form of Bluetooth Base caller system. This paper shows that with modern technology, emergencies occurring at the elevators can be drastically reduced to the barest minimum. The system is based on the embedded system and can act as a security guard of the buildings with several floors. When buildings consist of several floors, climbing it requires a lot of energy, hence the use of an elevator is an added advantage. Due to the risk involved in the use of elevator, there is need to communicate with the people on the elevator, this design provides access to the control room in the case of an emergency for people in the elevator. The elevator is normally operated by using switches via a Bluetooth. The main purpose of this paper is to design a Bluetooth Based Caller System in the elevator, which involves android phone technology (Bluetooth) and microcontroller technology.

**Key Words:** Bluetooth Module & Elevator.

## Introduction

Bluetooth is a high-end wireless technology designed for short range communications with high means of integrity. The application of Bluetooth technology in the design of a Bluetooth Based Caller System in elevators is an evolving concept in Elevator system. However, in these applications, the controller which is controlled via Bluetooth technology or the sensor which

transmits the sensed values via Bluetooth technology is application-specific. On the other hand, more productivity can be achieved by making the module general purpose, such that it can be used for wide range of applications. In fact, the general-purpose concept can be applied to a selected set of devices with standard data interfaces, by making the system general purpose to the developer rather than the end user. The communication between the controlling module and the remote server is done using Bluetooth technology. The server can communicate with many such modules simultaneously.

With the overall rapid development taking place in all spheres, the living standard of human being particularly in urban areas has tremendously increased as such the high-rise buildings are constructed for malls, and housing purposes. Thus, the installation of elevators in these high-rise buildings becomes an integral part of the infrastructure for the movement of goods and people. So, the control system is essential in the smooth and safe operation of the elevator. It guides the elevator in order to stop at floors, when to open or close the door etc. [1]. According to [2], elevator or lift is a transport device that is very common to us nowadays. We use it every day to move goods or peoples vertically in a high building such as Shopping Centre, working office, hotel and many more. It is a very useful device that moves people to the desired floor in the shortest time. This study documents the findings and results of a research on an elevator emergency control by using wireless technology (Bluetooth module) and micro-controller. It provides information, which is useful to those who wish to carry out a lift control system research or paper. In this study, emergency control system is going to be produced by using microcontroller.

The main aim of this Bluetooth Based Caller System in Elevator is to prevent the person in the elevator from any emergency. This buzzer starts ringing as soon as the people inside the elevator calls for an emergency. Thus, this paper is to demonstrate the use of Bluetooth based caller system in elevator by using wireless technology (Bluetooth). The objectives which this study is limited to include designing Bluetooth based caller system in elevator by using Arduino and wireless technology known as a Bluetooth, designing the program (software) for the overall system according to the real lift traffic management algorithm, and finally integrating the hardware and software in order to stimulate the functions of a basic lift system and app. This system was invented to overcome problems noticed on the old elevator such as manual operation and Emergency issue. This work introduces a new solution of elevator calling and controlling system which is based on microcontrollers. By the use of such design, complexity of the system has been simplified. This system helps to indicate limit of an elevator, the weight and number of people inside an elevator at a particular time. The system communicates with people inside an elevator with the help of LCD. This system contains an android application that the person in the elevator can use to

connect with the person outside the elevator via Bluetooth. At this time the system also counts the number of people present and increments a counter on each arrival and decrements when a person exits from the elevator. The system even includes a buzzer for demonstrating an alarm. The buzzer starts ringing as soon as a greater number of people enters the elevator than the limit of the elevator which is already set and the buzzer stops ringing only when the people inside the elevator come outside the elevator. This will cause the counter to be decremented and the buzzer stops ringing as soon as the counter is less or equal to the limit of the elevator set. The paper designed an effective elevator caller system, which can be reprogrammed in a fashion to minimize the congestion on a particular lane by directing the lift on a particular floor using time management scheme. Present scope of the project is to provide an automatic congestion control and hence found its importance in various fields of applications. It also helps to minimize/control emergency situations especially when one is stuck in an elevator.

**History of Bluetooth Based Caller System in Elevators**

According to [3], elevators began as a simple rope or chain hoists. An elevator is essentially a platform that is either pulled or pushed up by a mechanical means. A modern-day Elevator consists of a cab (also called a "cage" or "car") mounted on a platform within an enclosed space called a shaft or more correctly a hoist way. In the past elevator drive mechanisms were powered by steam and water hydraulic pistons. During the Middle Ages, the elevator operated by animal and human power or by water-driven mechanisms. The elevator as we know it today was first developed during the 1800s and relied on steam or hydraulic plungers for lifting capability. In the later application, the cab was affixed to a hollow plunger that lowered into an underground cylinder. Liquid, most commonly water, was injected into the cylinder to create pressure and make the plunger elevate the cab, which would simply lower by gravity as the water was removed. However, evolution in the development of elevator has led to the use of electrical application in the elevator design by the use of electric motors to drive the elevators.

**Bluetooth Technology**

Bluetooth, the new technology named after the 10th Century Danish King Harold Bluetooth, is a hot topic among wireless developers. The Bluetooth specification is an open specification that is governed by the Bluetooth Special Interest Group (SIG). The Bluetooth SIG is led by its five founding companies and four new member companies who were added in late 1999. These nine companies form the Promoter Group of the Bluetooth SIG:

**Founding Companies New Members**

- Ericsson
- 3Com Corporation
- IBM Corporation
- Lucent Technologies
- Intel Corporation
- Microsoft Corporation
- Nokia
- Motorola Inc.
- Toshiba Corporation

More than 1200 additional companies are members of the Bluetooth SIG.
It separates the frequency band into hops. This spread spectrum is used to hop from one channel to another, which adds a strong layer of security. Signals can be transmitted through walls and briefcases, thus eliminating the need for line-of-sight. Devices do not need to be pointed at each other, as signals are Omni-directional. Bluetooth is used in Phones and pagers and Headsets, Modems and LAN access devices, Notebook computers, Desktop and handheld computers, Printers and Fax machines, Keyboards and Joysticks.
The paper is arranged as follows, the section 2 talks about proposed system, the section 3 talks about the results and discussion, the section 4 talks about the recommendation and conclusion the last section talks about the references.

**The Proposed Bluetooth Based Caller System in Elevators**

The major aim of this paper is to demonstrate how Bluetooth finds its application into the safety of the elevator user by developing a Bluetooth Based Caller system in Elevators. The components used are described in this section, the proposed system with a circuit diagrams, its principle of operations will be well explained, also, it has the Android Application Software for the system. The aim of this research is to demonstrate a new wireless technology for communicating with people outside the elevator. For wireless technology Bluetooth module is used because Bluetooth wireless technology is becoming a popular standard in the communication arena, and it is one of the fastest growing fields in the wireless technologies. It is convenient, easy to use and has the bandwidth to meet most of today's demands for mobile and personal communications [4]. There are different techniques for calling for emergency in the elevator. Microcontroller finds a best method for communicating the people outside the elevator.

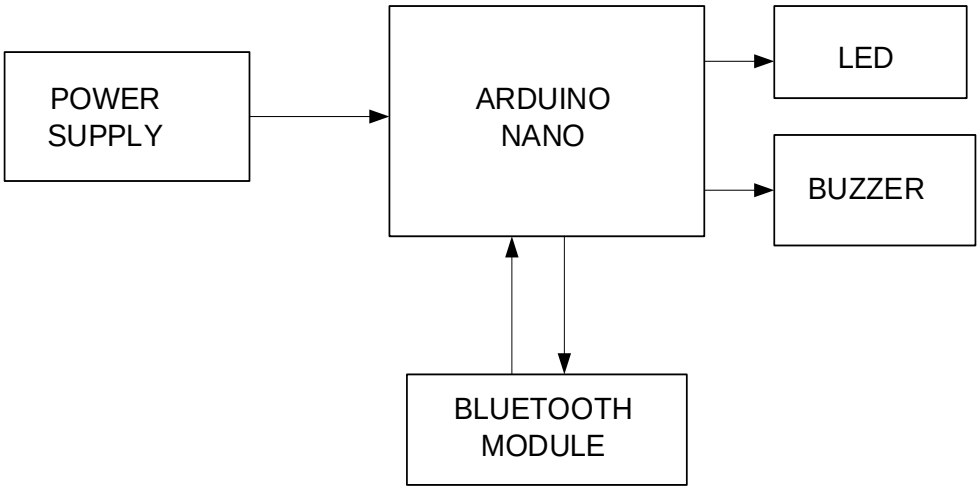


**Figure 1 Block Diagram of the System**

**Materials and Method**

The materials used on this design includes:

- Microcontroller (Arduino)
- Bluetooth module
- LCD
- Resistors
- Capacitors
- Diodes
- Regulator

The traditional development methodology was used for the execution of this project and the top-down design approach was adopted for both hardware and software developments. This method comprises of:

- Research and study
- Planning
- Designing
- Implementation
- Testing
- Improvement

**Arduino Hardware**

Over the years, Arduino has released hundreds of hardware designs in many shapes and forms. While all Arduino boards differ from each other, there are several key components that can be found on practically any Arduino. Fig 2 shows the pictorial view of the sections of Arduino.

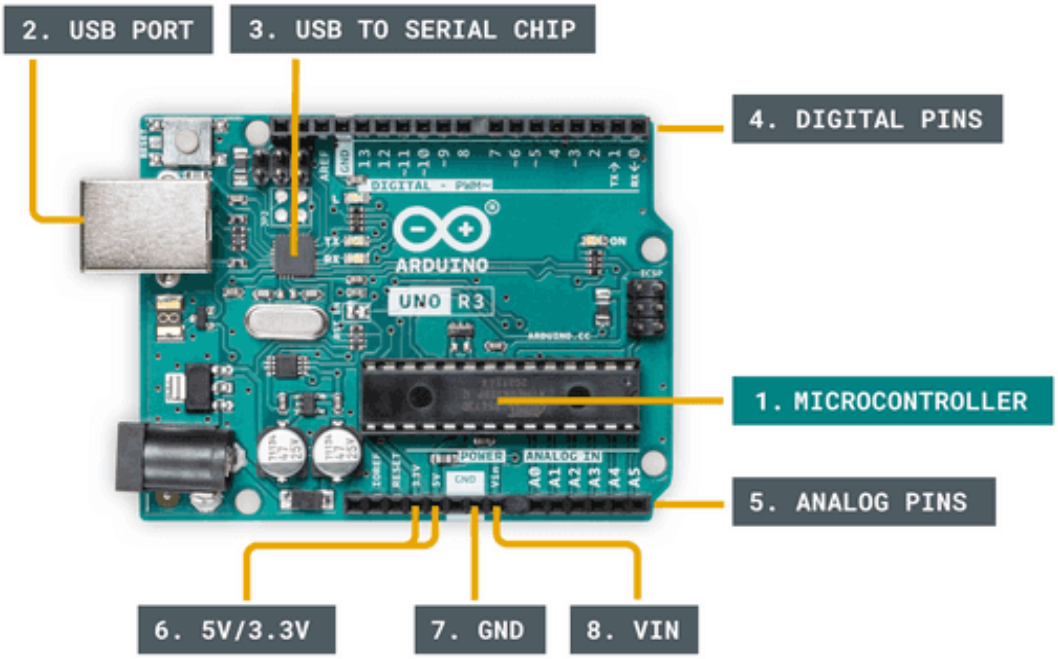


**Figure 2 Key components of an Arduino Board.**

Let us look at different parts of the Arduino.

**Microcontroller** - this is the brain of an Arduino, and is the component that we load programs into. Think of it as a tiny computer, designed to execute only a specific number of things.

**USB port** - used to connect your Arduino board to a computer.

**USB to Serial chip** - the USB to Serial is an important component, as it helps translating data that comes from e.g., a computer to the on-board microcontroller. This is what makes it possible to program the Arduino board from your computer.

**4. Digital pins** - pins that use digital logic (0,1 or LOW/HIGH). Commonly used for switches and to turn on/off an LED.

**5. Analog pins** - pins that can read analog values in a 10-bit resolution (0-1023).

**6. 5/3.3 V pins**- these pins are used to power external components.

**7. GND** - also known as ground negative or simply is used to complete a circuit, where the electrical level is at 0 volt.

**8. VIN** - stands for Voltage In, where you can connect external power supplies.

Depending on the Arduino board, you will find many more components. The items listed above are generally found on any Arduino board.

**Basic Operation**

Most Arduino boards are designed to have a single program running on the microcontroller. This program can be designed to perform one single action, such as

blinking an LED. It can also be designed to execute hundreds of actions in a cycle. The scope varies from one program to another.
The program that is loaded to the microcontroller will start execution as soon as it is powered. Every program has a function called "loop". Inside the loop function, you can for example:

1. Read a sensor.
2. Turn on a light.
3. Check whether a condition is met.
4. All of the above.

The speed of a program is incredibly fast, unless we tell it to slow down. It depends on the size of the program and how long it takes for the microcontroller to execute it, but it is generally in **microseconds (one millionth of a second).**

**Bluetooth Module:**
Bluetooth operates at frequencies between 2400 and 2483.5 MHz (including guard bands). This is in the globally unlicensed (but not unregulated) Industrial, Scientific and Medical (ISM) 2.4 GHz short-range radio frequency band. Bluetooth uses a radio technology called frequency-hopping spread spectrum. Bluetooth divides transmitted data into packets, and transmits each packet on one of 79 designated Bluetooth channels. Each channel has a bandwidth of 1 MHz Bluetooth uses 2 MHz spacing, which accommodates 40 channels. The first channel starts at 2402 MHz and continues up to 2480 MHz in 1 MHz steps. It usually performs 1600 hops per second, with Adaptive Frequency-Hopping (AFH) enabled. A master Bluetooth device can communicate with a maximum of seven devices in a piscine (an ad-hoc computer network using Bluetooth technology), though not all devices reach this maximum. The devices can switch roles, by agreement, and the slave can become the master (for example, a headset initiating a connection to a phone necessarily begins as master or initiator of the connection but may subsequently operate as slave).

**Power Supply Unit:**
We initially provide 7.4 V DC supply to the power circuit unit. The LM7805 regulator regulated the 7.4v DC to 5.1 V supply. This 5.1 V supply is given to the Circuit.

**Liquid crystal display (LCD):**
This is the screen to communicate the state of the people in the elevator with person outside the elevator.

**Buzzer:**
This is a 12 V dc buzzer that makes sound once there is emergency in the elevator and will stop when the reset button is pressed from the hardware interface.

**Principle of Operation of Bluetooth Based Caller System in Elevators**

From the fig 3 we can see the schematic diagram of the deigned system, the system mode of operation is such that when the device is powered, it will display on the LCD, "Bluetooth based calling system in elevator" and after 3 seconds, it will display "you are welcome". The person in the elevator will have to connect to the Bluetooth network using the app. Whenever danger is seen by the people in the elevator, the person will click on the emergency button on the app and the device will reply by asking the person which floor is that, and in return the person will have to select if it is the 1st, 2nd, and 3rd floor and the buzzer will start sounding and also replying by telling the person, ok, we are coming to the floor and once people have finish attending to the elevator fault and press the reset button, the buzzer will stop and the device will reply the person, “The problem have been Resolved.” All this within the space of 10 seconds.

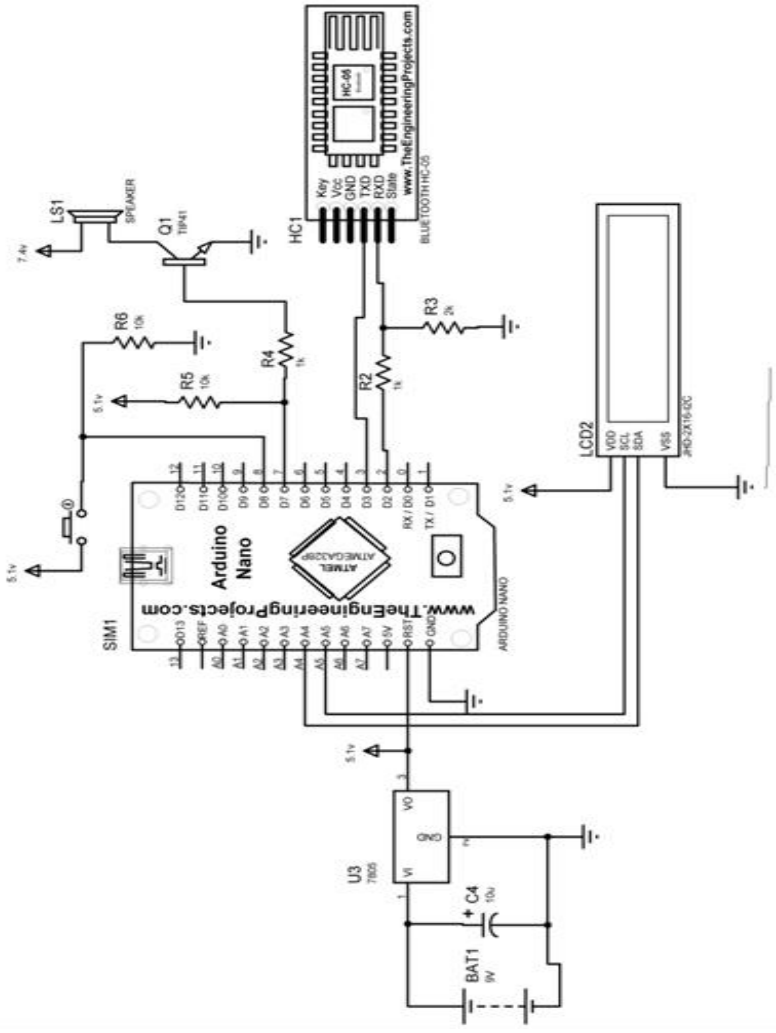


**Figure 3 Circuit Diagram System of Bluetooth Based Caller System in Elevators**

**The Android Application Software creating page for the project**

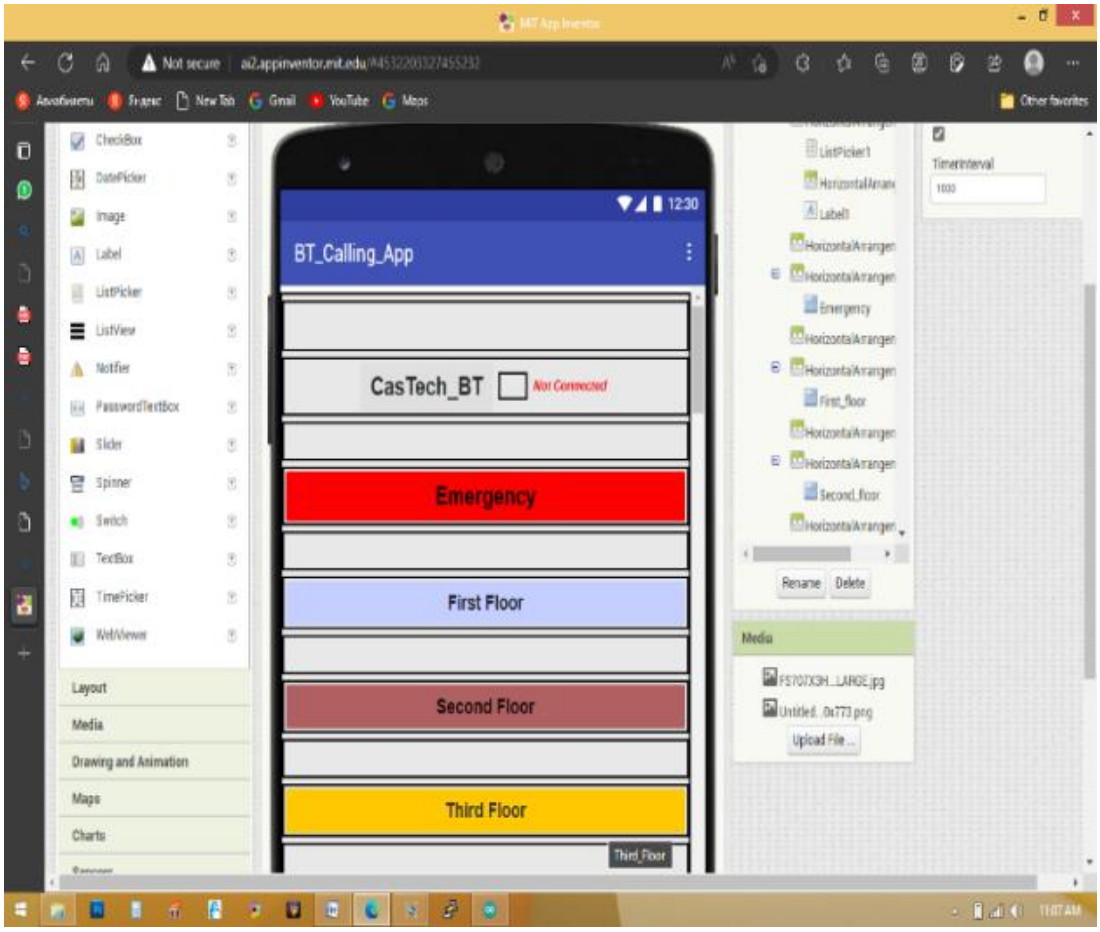


**Figure 4 the software interface**

Fig.4 shows the android phone interface that connect to the Bluetooth designed system for communication. The interface BT_Calling_App is the connecting device to the Bluetooth designed system. The Emergency interface shows state of emergency on the floors of the building, the First, second, third etc. shows the floor the Elevator/lift is located.

**Designed Procedure**

In building this project, the following procedures were properly considered,

I. Purchasing of the entire materials/Components needed
ii. Resistance checks of the components bought with the help of ohmmeter before making the necessary connection with the components
iii. Drafting out a schematic diagram or how to arrange the materials/components.
iv. Testing the completed system to see if the design works and
v. Finally, implementation of design of the project.

Having procured all the materials, I processed into the arrangement of the components into the Vero board, proper soldering of the components then followed. The components were all soldered into the board after which it was correctly confirmed done.

**Casing and Packaging**

The casing of this project comprises of internal and external packaging. Internal parts of the circuit were soldered and fixed inside the case. Then after that, follow by external components such as indicators, switch, and buzzer.

**RESULT AND DISCUSSION**

This project could be used to signify when there is power supply in the main. This system alerts the user to switch on his/her appliances.

The system has a buzzer, toggle switch, and power indicator, and also input plug are also made available and all mounted on the body of the casing. The toggle switch is used to switch the system ON.

**Experimental Set Up**

Having provided the casing and having finished the construction of the sections of this system, the assembling into the casing followed. The sections were properly laid out and assembled into the casing where the general coupling and linkages into the peripheral devices took place.

Finally; the indicator, switch, buzzer was carefully brought out from the internal part of the casing through the holes made on the body of the casing, the input cable plug outlet mounted on the body of the casing where power source terminals will be connected to.

**Results**

In this stage, the system was due for testing and operation. The system operation was tested where all its required performance was maintained.

Firstly, the device was connected and switch ON with the toggle switch, then the system is set for operation, by this time the buzzer will sound showing that there is a power supply, and it sound with a predetermined time and when the device was interrupted the failure alarm start blowing which later fades away. The indicator lamp is also connected whose function is mainly to indicate the presence of voltage into the system or when the power fails or restored.

This system is designed that whenever one gets stuck in an elevator, the person will connect to the Bluetooth calling system using the BT calling App.

When the system is turned on, it will display on the system "Bluetooth calling system". Then afterwards "You are welcome" see fig. 5.


**Figure 5a LED Interface**

After the Bluetooth calling App is connected to the Bluetooth device see fig. 5b; i.e., the Bluetooth calling system, it will display on the top part of the Android app "connected".

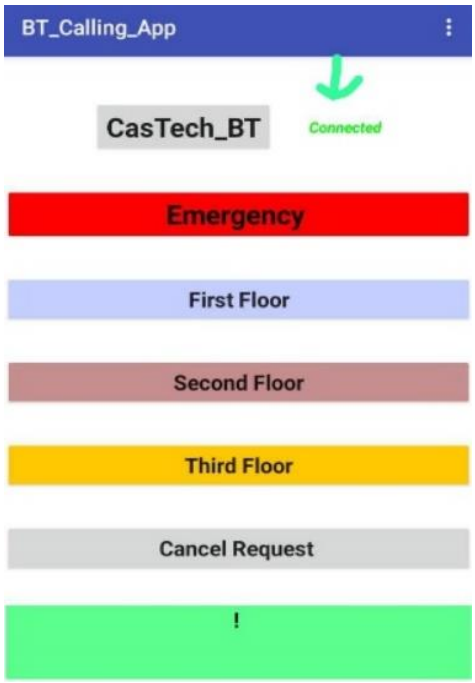


**Figure 5b Android Phone Interface**

From fig. 6a; you can the Emergency displayed on the LED interface. When an Emergency occurs in the elevator, the person stuck clicks in the "emergency button", displaying on the Bluetooth system "emergency occur at the elevator".


**Figure 6a Shows hoe Emergency is displayed on the LED**

The system itself will reply without any interface "which floor is that?" on the down part of the Android app.

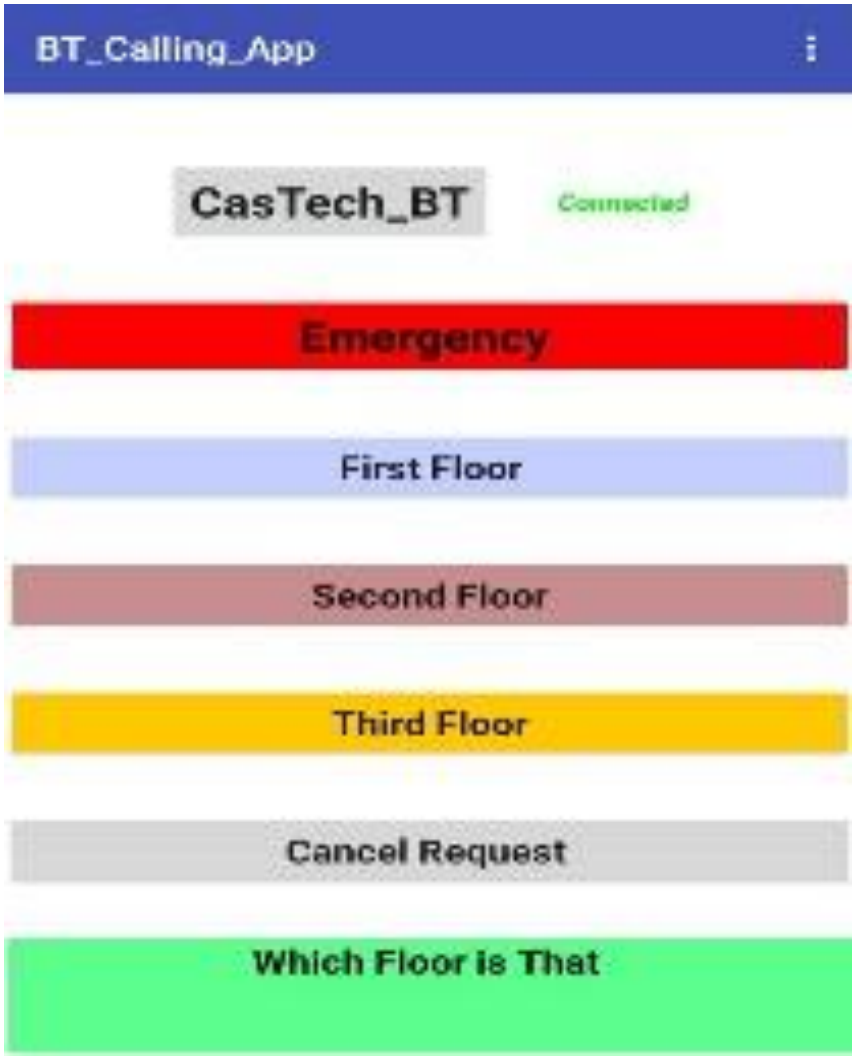


**Figure 6b Android Phone interface on Emergency**

From fig 7a, assuming it is the "second floor" the person clicked; it will display on the system 'Emergency occur at the 2nd floor".


**Figure 7a shows Emergency on the Second Floor**

And on the Android App, will display “Ok! We are coming to the 2nd floor now”.

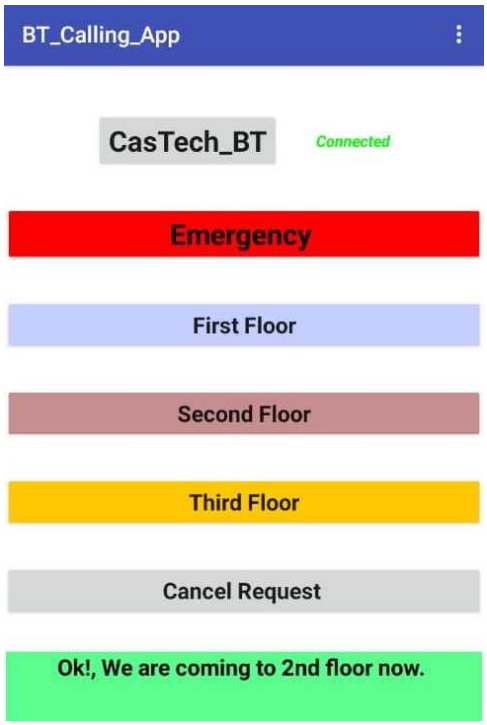


**Figure 7b shows Emergency on the Second Floor**

Immediately after that particular communication, the alarm (buzzer) will start blowing.

In a situation whereby one made a mistake out of fear or anxiety clicked on the wrong floor the emergency occurred, the person will click on “cancel request” in the Android app.

The alarm will stop and it will display on the system “wrong location please!!!” And on the Android app, “please tell us your new location’.

Then the person indicates the exact location the emergency occurred. For instance, if it is first floor that is clicked on, it will display on the system “Emergency occur at the 1st floor”. That is when the person will indicate the exact floor the emergency occurred. And on the Android app, it will display "Ok! We are coming to the 1st floor now".

After the issue is resolved or been attended to, the technician will press the reset button, and it will display again on the Android app "The problem have been resolved".

**Discussion**

From the result obtained, when the designed Bluetooth Based Caller system in elevators was tested, it shows that this gadget worked based on designed specification and the device performed excellently with a 90% efficiency. The two Bluetooth with its interface, LED interface and their respective password were a very good means of authentication for the device. The designed system worked perfectly well within the specified radius of about 10m.

## CONCLUSION AND RECOMMENDATION

The user of this technology stands to have many benefits which include:

a. Automatic communication with people outside the elevator.
b. To reduce the risk of fire and explosion in the system.
c. Emergency alarm can reduce accidents and risk to human life.

As we all know that every engineering work goes with one or more problem, which enhances research and probably technological advancement to engineers while endeavoring to resolve such problem. Therefore, the designed work on discussion suffers some noticeable drawback, which includes:

- Mechanical problem: we found it difficult to install all the external components. But after the effort was made, our aim was later achieved.

**Conclusion**

This study deals with programming and through it we can communicate the people outside the elevator with the means Bluetooth technology using an android application as an interface for the people inside the elevator and a liquid crystal display as an interface for the person outside. A note command is generated at each and every stage of elevator and when the persons in the elevator encounters any issue, with the app he/she can communicate outside telling them the floor where the issue occurred. Bluetooth is used as a wireless technology to transfer data from mobile to the elevator and vice versa.

**Recommendation**

This technology is recommended to both residential and commercial buildings with high population of people in it. Specially it could be recommended to:

- Shopping Malls
- Hotels

- Banks
- Academic Institutions
- Hospitals etc.

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