

# RFID and GSM based Intelligent Courier Mailbox System

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**Abstract:** This paper describes a device which is capable of identifying the arrival of the courier and forward the same to the receiver. The idea behind this project is to employ an RFID tag to the courier and send the identity number to the user. The user feeds the identity number in the microcontroller using GSM. On the receiver side there is a letterbox which has a RFID reader, GSM module and LCD screen. The courier person scans the RFID tag on the courier using the RFID Reader present at the letterbox. If the identity number matches with the identity number fed by the user, the RFID reader sends a command to the microcontroller to open the gate of the letterbox. The Microcontroller is connected to the DC motor which rotates resulting in the opening of gate. The Microcontroller is programmed in such a manner that after the opening of the gate it automatically closes after 15 seconds. In the event of mismatch of identity number an error message is displayed on the LCD screen.

**Keywords:** RFID, GSM, Tag, RFID reader, microcontroller, Motor Drive and Motor.

## 1. Introduction

An intelligent courier mailbox system which is capable of automatically sending information about mail to user and delivery notification to courier officials. As the time moves the life style of the persons has completely changed and there is no time for the people for micro management of every issue personally. So, this is the right time to provide some space to the technology into our lives for monitoring the issues which requires our personal presence for the things to happen. One among those issues which require our personal presence is receiving the courier which is sent back if we are not present at the time the courier boy comes to our house. This may lead to the delay in receiving the important information and in some scenarios, it may also lead to tough situations. So, our project aims in providing a very reliable and very user-friendly solution to overcome this kind of problem. As we know the advancements in the Radio Frequency and GSM technologies and making use of those existing technologies we can design a device which is capable of identifying the arrival of courier and forward the same to the person who need to receive the mail and also send an acknowledgement to the courier office so that they do not require the signature of the particular person for whom the courier is meant for. The basic idea of the system is to employ an RFID tag to the courier and send the identity

number to the receivers mobile. The receiver of the courier will have a letter box whose opening and closing is made automatically using Geared DC motor, which has an RF reader and a dedicated GSM modem in it. As soon as the courier boy drops the letter in to the letter box it the RF reader reads the identity number of the tag and informs the same to the micro controller and compares it with the identity number send by the courier office and if both are same, then it sends message to the receiver and also to the courier office about the arrival of the courier. To design the entire system, we require a microcontroller which acts as a medium of communication between the RF reader and the GSM modem. The major advantage of this system is the presence of the GSM modem enables the device to communicate with the receiver no matter where ever he was present on the globe (GSM availability).

## 2. Project overview

An embedded system is a combination of software and hardware to perform a dedicated task. Some of the main devices used in embedded products are Microprocessors and Microcontrollers. Microprocessors are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the result.

*The RFID and GSM based intelligent courier mailbox system with automatic delivery notification using PIC16F877A microcontroller is an exclusive project which is used to design an intelligent courier mailbox system which is capable of automatically sending information about mail to user and delivery notification to courier officials*

## 3. History

In the earliest years of computers in the 1930–40s, computers were sometimes dedicated to a single task, but were far too large and expensive for most kinds of tasks performed by embedded computers of today. Over time however, the concept of programmable controllers evolved from traditional electromechanical sequencers, via solid state devices, to the use of computer technology.

One of the first recognizably modern embedded systems was the Apollo Guidance Computer, developed by Charles Stark Draper at the MIT Instrumentation Laboratory. At the project's inception, the Apollo guidance computer was considered the riskiest item in the Apollo project as it employed the then newly developed monolithic integrated circuits to reduce the size and weight. An 8 early mass-produced embedded system was the Automatics D-17 guidance computer for the Minuteman missile, released in 1961. It was built from transistor logic and had a hard disk for main memory. When the Minuteman II went into production in 1966, the D-17 was replaced with a new computer that was the first high-volume use of integrated circuits.

#### 4. Proposed system

Each courier is attached with RFID tag and sends the identity number to receivers mobile. When the courier boy arrives, the RFID tag on the courier is read by RFID reader. When the tag matches, letter box is automatically opened using geared DC motor, then it sends message to receiver about arrival of the courier. When the receiver takes the courier from letter box, an acknowledgment is sent to courier office.

Basic Block: The main blocks of this system are:

- Micro controller (16F877A)
- Reset button
- Crystal oscillator
- Regulated power supply (RPS)
- LED indicator.
- RFID module.
- GSM modem.
- RS232 cable.
- LCD.

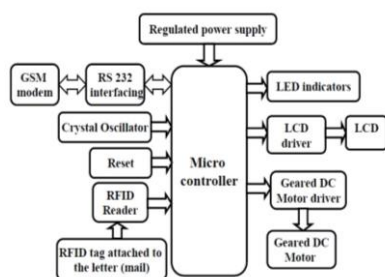


Fig. 1. Block diagram

#### A. GSM Modem

GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc.) for computer. The MODEM is the soul of such modules.

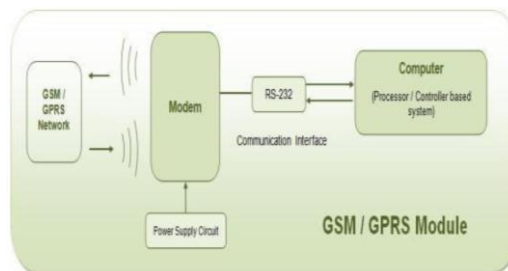


Fig. 2. GSM modem

#### B. RFID

RFID is a very promising technology with significant impact. Following are the reasons for us to use this technology for students' administration application.

- No line of sight required.
- Tags can be read from significant distances.
- Multiple tags can be read at the same time.
- Because tags must be enclosed, they are much more difficult to tamper.
- Many tags are read / write capable, rather than read only.

A fundamental component in this transformation has been radio frequency identification (RFID) a „next generation“ technology that has long been touted by suppliers as a miracle cure for improved efficiencies of secured postal data communication using RFID within the supply chain. Radio Frequency Identification RFID is the reading of information on small devices using radio frequencies or thereabouts. It largely avoids the problems of human error and cost, of miss orientation, obscurity and needing to read many at a time that plague barcodes, phosphor dots, print and other alternatives in the postal and courier service. It is an enabling technology of incredibly broad applicability. That is why RFID is already used in the postal and courier service for secure access by people to vehicles and secure areas, secure access of vehicles to yards, location of parcels, conveyances, trailers and much more besides. RFID monitors the performance of the letter post, matches letters to postal boxes to prevent errors and records when and how much a sensitive package has been overheated in transit. RFID technology has massive potential for the postal sector because it's primarily used to track items that are constantly on the move". The concept of RFID technology is relatively simple. To start with, a special tag is placed on each item that requires tracking, for example a small parcel that is travelling from Doha to Dubai. The tags are more versatile than barcodes and have been designed to carry a greater amount of information. Moreover, barcodes are read-only, whereas the data on RFID tags can be updated at different stages of the journey.

#### C. Microcontroller (PIC16F877A)

Circumstances that we find ourselves in today in the field of microcontrollers had their beginnings in the development of technology of integrated circuits. This development has made it

Table 1  
EPC RFID classes

EPC DEVICE Class	Definition	Programming
Class 0	“Read Only” passive tags	Programmed by the manufacture
Class 1	“Write-once, read-many” passive tags	Programmed by the customer; cannot be reprogrammed
Class 2	Rewritable passive tags	Reprogrammed
Class 3	Semi passive tags	
Class 4	Active tags	
Class 5	Reader	

Table 2  
EPC RFID Generation

EPC RFID classes		
Feature	Generation 1	Generation 2
Frequency	860-930MHz	860-960MHz
Memory capacity	64 or 96 bits	96-256 bits
Field-programmability	Yes	Yes
Programmability	Class0- read only Class 1- write once/ ready many	NA
Another Feature	NA	Faster and more reliable reads than Generation 1 Better Compliance with other global standards

possible to store hundreds of thousands of transistors into one chip. That was a prerequisite for production of microprocessors, and the first computers were made by adding external peripherals such as memory, input-output lines, timers and other. Further increasing of the volume of the package resulted in creation of integrated circuits. These integrated circuits contained both processor and peripherals. That is how the first chip containing a microcomputer, or what would later be known as a microcontroller came about. Microprocessors and microcontrollers are widely used in embedded systems products. Microcontroller is a programmable device. A microcontroller has a CPU in addition to a fixed amount of RAM, ROM, I/O ports and a timer embedded all on a single chip. The fixed amount of on-chip ROM, RAM and number of I/O ports in microcontrollers makes them ideal for many applications in which cost and space are critical. PIC stands for Peripheral Interface Controller given by Microchip Technology to identify its single-chip microcontrollers. These devices have been very successful in 8-bit microcontrollers. The main reason is that Microchip Technology has continuously upgraded the device architecture and added needed peripherals to the microcontroller to suit customers' requirements.

*Low-end PIC Architectures:* Microchip PIC microcontrollers are available in various types. When PIC microcontroller MCU was first available from General Instruments in early 1980's, the microcontroller consisted of a simple processor executing 12-bit wide instructions with basic I/O functions. These devices are

known as low-end architectures. They have limited program memory and are meant for applications requiring simple interface functions and small program & data memories. Some of the low-end device numbers are

12C5XX

16C5X

16C505

*Mid-range PIC Architectures:* Mid-range PIC architectures are built by upgrading low-end architectures with a greater number of peripherals, a greater number of registers and more data/program memory. Some of the mid-range devices are

16C6X

16C7X

16F87X

Program memory type is indicated by an alphabet.

C = EPROM, F = Flash, RC = Mask ROM

Popularity of the PIC microcontrollers is due to the following factors.

- *Speed:* Harvard Architecture, RISC architecture, 1 instruction cycle = 4 clock cycles.
- *Instruction set simplicity:* The instruction set consists of just 35 instructions (as opposed to 111 instructions for 8051).
- *Power-on-reset and brown-out reset.* Brown-out-reset means when the power supply goes below a specified voltage (say 4V), it causes PIC to reset; hence malfunction is avoided. A watch dog timer (user programmable) resets the processor if the software/program ever malfunctions and deviates from its normal operation.
- *PIC microcontroller* has four optional clock sources.
- Low power crystal
- Mid-range crystal
- High range crystal RC oscillator (low cost).
- Programmable timers and on-chip ADC.
- Up to 12 independent interrupt sources.

#### D. Motor Drive and Motor

Opening and closing of the box is done automatically using geared dc motor. Driver is used to boost the current. The current from microcontroller is not sufficient enough to rotate the motors a current amplifier is used. L293D is used to drive the motor. L293 Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads. To simplify use as two bridges each pair of channels is equipped with an enable input. A separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included. The L293D is assembled in a 16-lead plastic package which has 4 center pins connected together and used for heat sinking. The L293D is assembled in a 20-lead surface mount which has 8 center pins connected together and used for heat sinking.

### 5. Operational description

Each courier is attached with an RFID tag and the tag number is sent to the GSM modem present in the letter box system. This tag number is stored in the microcontroller present at the letter box system. When the courier boy arrives at the owner's place, the RFID reader reads the tag number attached to the courier and this data is sent to the microcontroller. The microcontroller compares this received data with the previously stored value, if there is a mismatch between these two values the system won't allow the courier boy to place the courier. If the tag number matches the motor rotates in clockwise direction with the help of motor drive IC L293D which indicates opening of door of the letter box system. After placing the courier in the letter box, the motor rotates in anti-clockwise direction so that door is closed immediately. This ensures that the courier is delivered to the right address. After placing the courier, the GSM modem sends a message to the owner that a courier has been placed. Owner has a separate RFID card for opening the letter box system. This tag number is already stored in the system. When the owner shows his card the letter box gets open and he can take the courier. Once he takes the courier from the letter box, a delivery notification is sent to the courier office. Even without the physical presence of owner, the courier can be delivered with security.

### 6. Benefits of implementing RFID and GSM based system in postal services

As a conclusion we can state that tagging mail and mailboxes would result in:

- Overall reduced rate of mail delivery error
- Less human errors, more efficient working hours in sorting and deliveries
- Satisfied customers who trust the system
- Less money spent on investigating lost mail
- Real-time up-to-date database
- 100% exact mail traceability service for customers
- Less vandalism of mailboxes.
- Reduced handling costs for customers, increased competitiveness
- More efficient and flexible operations, shorter

delivery times Enhanced security and safety

- Cheaper return package costs (for online shopping)
- Highly efficient and user-friendly design
- Easy to operate
- Low power consumption
- Efficient design
- Works anywhere in the world (GSM availability)

### 7. Conclusions

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus, the project has been successfully designed and tested. Intelligent mailbox system with automatic delivery notification is designed such that an automatic sending information about mail to user and delivery notification to courier officials from an intelligent courier mailbox system. Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus, the project has been successfully designed and tested.

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