Development of RFID Based Automatic System for Saving Suicides at Metro Railway Stations

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ABSTRACT
Radio Frequency Identification (RFID) system is being used in various fields of engineering and automation in recent times. Every year, lot of people commits suicide at metro stations by jumping before the metro trains. Metro railways are a pride of Kolkata as well as India. Such suicides create a lot of inconvenience for the commuters as well as routine operation of train services. Such suicide deaths need to be prevented immediately. In our present work we have developed a prototype and tested successfully a RFID based automatic intelligent system for avoiding such suicide deaths at metro stations. Our system is secured, reliable and intelligent because of RFID and advanced processor employed in the designed system.

General Terms
Embedded system design and development using RFID and advanced processor for real life applications.

Keywords
RFID, Reader, Relay, Stamp processor, tag

1. INTRODUCTION
More and more people commit suicide every year at metro railway stations. The electricity is given to metro trains via the tracks. There is a risk of danger involved, even someone goes down the metro track and touches the electric track. The record shows 186 people try to commit suicide at various metro stations, since 1988 in Kolkata, India. Out of whom 86 have died till April 2010. The persons jump from the platform before an entering train. The driver doesn't get a chance to save the person. These suicide deaths disrupt the regular metro service for hours together. These suicide deaths happen before hundreds of people at platform and causes lot of physical and psychological problems. In this paper we have attempted and proposed an intelligent system that will not allow any person to jump over a metro tracks and hence suicides can be avoided at metro stations. This paper is organized as follows: In section II the RFID System is described in brief. Section III describes the scheme and operation of the designed system. In section IV, we described the technical details of the developed prototype system. In section V, the advantages of the designed system and finally the conclusion in section VI.

2. RFID IN BRIEF
RFID stands for Radio Frequency Identification, a term that describes any system of identification wherein an electronic device that uses radio frequency or magnetic field variations to communicate is attached to an item [1]. RFID systems have been widely used in many application areas, such as: inventory control, container tracking, ID badges and access control, equipment/patient tracking in hospitals, etc [2].

RFID systems use radio waves to store and retrieve data from an identification chip through a wireless communication to a host computer [3]. A RFID system consists of three key components: RFID tag or transponder, reader/writer or interrogator and the application computer or processor. The reader communicates with a tag in its wireless range and collects information about the objects to which tags are attached [4]. RFID has several advantages, such as: tag data can read automatically without line-of-sight, thought some materials, simultaneously tag reading and from a range of several meters [5]. The RFID reader and tag can radio-communicate with each other using a number of different frequencies, and currently most RFID systems use unlicensed spectrum. The common frequencies used are low frequencies (125 KHz), high frequency (13.56 MHz), ultra high frequency (860–960 MHz), and microwave frequency (2.4 GHz). The typical RFID readers are able to read (or detect) the tags of only a single frequency but multimode readers are becoming cheaper and popular which are capable of reading the tags of different frequencies [6]. The tags can be active or passive. The active tags use battery for its operation but passive tags do not need battery. These are energized by the radiation from RFID reader [2].

3. DESCRIPTION OF THE SYSTEM
In our designed prototype there will be a glass enclosure and glass door on the platform as shown in fig. 2. The number of doors and location of these doors on platform will be as per the train doors. The doors of platform are operated by AC motor. The schematic diagram of operation of these doors is shown in fig 3. The operation mechanism of these doors of platform will be as follows: When power is given to the AC motors they open these gates. When it is fully opened, electromagnets are actuated to hold it in position. After few seconds this electromagnet is deactivated and the gate comes back to closed condition for restoring action of load W. RFID tags having low range will be fitted on train chassis and also on platform lower walls as shown in fig.1 and fig.2. There will be two sets of readers along with some extra circuit fitted on the chassis of driver and guard cabin. There will be another two sets of tags and readers fitted on the platform. The tags on the platform are sensed by the readers of train and the tags on the train chassis are sensed by the readers attached to platform. The tags and corresponding reader is at same height for better sensing purpose. Each end reader fitted on platform can operate half of the doors of the platform. When a train reaches a platform and stops at particular marked location, the tags on platform is read by train reader and the tags on train chassis is read by platform reader. If the tag identity matches with the stored tag identity, then the doors of platform and train will open.

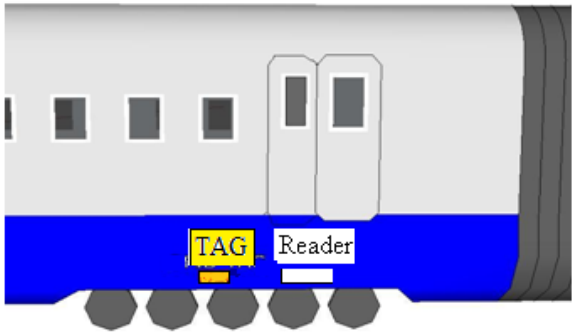


Fig.1: Location of RFID reader and the tag on the metro train

Fig.2: Glass enclosure with doors on the platform with RFID reader and tags

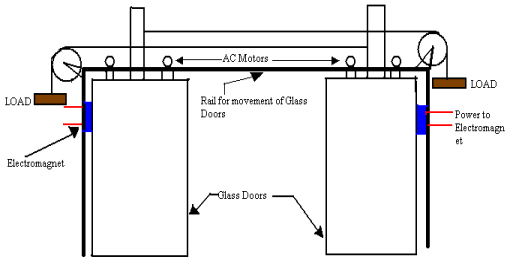


Fig.3: Operation scheme of the doors

The overall operation of the whole system is as follows. The driver stops the train at particular marked location. There will be an announcement in public address system of the train to mention the name of the station and to indicate that the gate is opening. Now the gates of the platform open first and then the doors of train opens for some predefined duration. The doors of train will close first and then the doors of platform will close. The train again starts. The decision that the train has reached the platform at exact location is made by the RFID readers by sensing the tags. The details of technical operations that are done by RFID reader along with the added hardware are mentioned below.

3.1 Operations of the reader on the train

- The reader reads the platform tag
- Plays a record indicating the door is opening.
- Puts AC power to gates after 2 sec for n second (Programmable) to open the gates.
- The doors remain open due to latching action of electromagnet at door ends.
- When the power of latching electromagnet is off, AC power is given to the gates come back to their closed position.

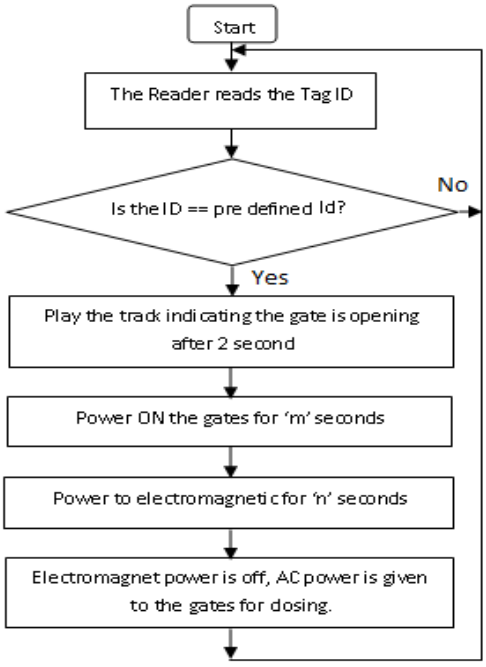


Fig.4: Operation of the reader on the platform

3.2 Operation of the reader on the platform:

- Reader reads the train chassis tag.
- Plays a track indicating the door is opening.
- Puts power to AC motors of gates for n second (Programmable) to open the gates.
- The doors remain open due to latching action of electromagnets at door ends.
- When the power of latching electromagnet is off the gates come back to their position for restoring force by load W.

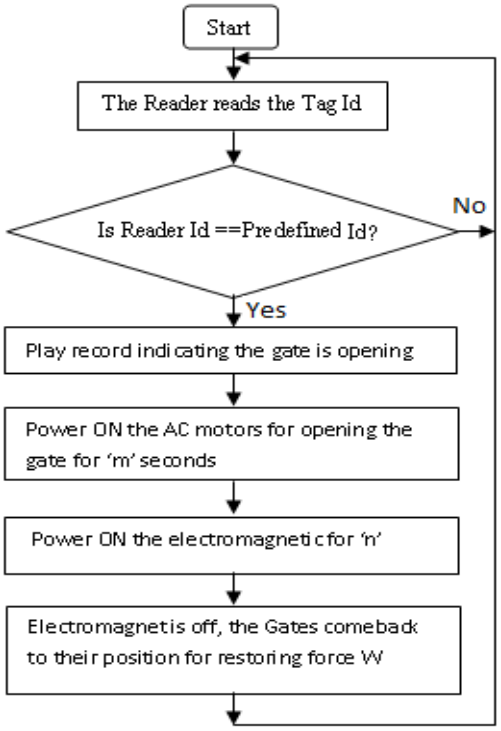


Fig 5: operation of the reader on the train.

4. IMPLEMENTATION OF THE SYSTEM

We have implemented our system by RFID reader, Stamp processor, RFID tags, and a special hardware board developed by us. The intelligence of our designed system residing on the RFID system and the processor we used. The RFID tags have a specific identity code. The reader interrogates the tag and can read the identity of tags. The RFID reader and the tag that are used have the following specifications:

The Parallax Radio Frequency Identification (RFID) Reader Module shown in Fig.6 is a low-cost solution to read passive RFID transponder tags up to 1¾" - 3" inches away depending on the tag. The RFID Reader Module can be used in a wide variety of hobbyist and commercial applications, including access control, automatic identification, robotics navigation, inventory tracking, payment systems, and car immobilization. This reader has following specifications:

- Fully-integrated, low-cost method of reading passive RFID transponder tags
- Single-wire, 2400 baud Serial TTL interface to PC, BASIC Stamp® and other processors
- Requires single +5VDC supply
- Bi-color LED for visual indication of activity

0.100" pin spacing for easy prototyping and integration.

The Parallax RFID Reader Module works exclusively with the EM Microelectronics-Marin SA EM4100-family of passive read-only transponder tags. A variety of different tag types and styles exist with the most popular made available from Parallax. Each transponder tag contains a unique identifier (one of 240, or 1,099,511,627,776, possible combinations) that is read by the RFID Reader Module and transmitted to the host via a simple serial interface.

Fig.6: The parallax reader module

Electronic Connections

The Parallax RFID Reader Module can be integrated into any design using only four connections (VCC, /ENABLE, SOUT, GND). Following circuit for connecting the Parallax RFID Reader Module to the BASIC Stamp microcontroller:

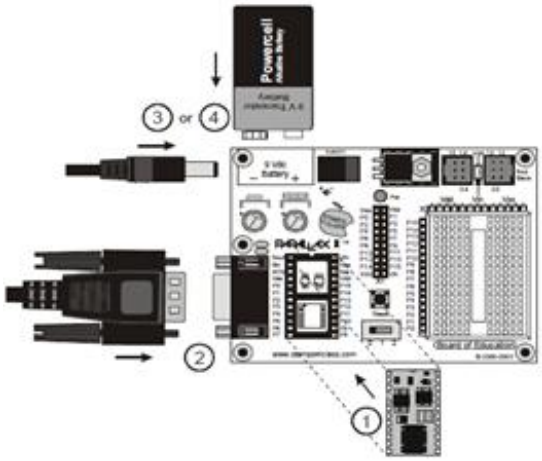


Fig.7: The Stamp processor with attached board

The reader is fitted with stamp processor is shown in Fig.7. The ID of tag which is read by the reader is transferred to the processor. We have used a modern stamp processor for our design. This processor has following specifications

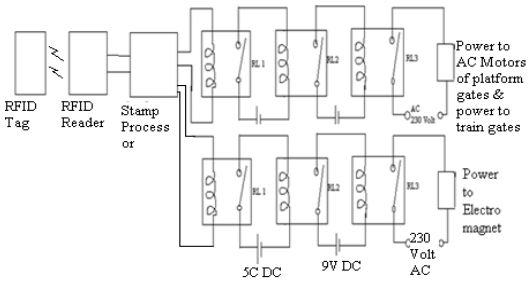
Stamp Processor: The stamp processor is a very strong processor. BASIC Stamp microcontrollers have been in use by engineers and hobbyists since it was first introduced them in 1992. As of November 2004, Parallax customers have put well over three million BASIC Stamp modules into use. Over this 12-year period, the BASIC Stamp line of controllers has evolved into six models and many physical package types.

General Operation Theory : BASIC Stamp modules are microcontrollers (tiny computers) that are designed for use in a wide array of applications. Many projects that require an embedded system with some level of intelligence can use a BASIC Stamp module as the controller. Each BASIC Stamp comes with a BASIC Interpreter chip, internal memory (RAM and EEPROM), a 5-volt regulator, a number of general-purpose I/O pins (TTL-level, 0-5 volts), and a set of built-in commands for math and I/O pin operations. BASIC Stamp modules are capable of running a few thousand instructions per second and are programmed with a simplified, but customized form of the BASIC programming language, called PBASIC.

PBASIC Language: Parallax developed PBASIC specifically for the BASIC Stamp as a simple, easy to learn language that

is also well suited for this architecture, and highly optimized for embedded control. It includes many of the instructions featured in other forms of BASIC (GOTO, FOR...NEXT, IF...THEN…ELSE) as well as some specialized instructions (SERIN, PWM, BUTTON, COUNT and DTMFOUT).

The programming of the processor is done by using PBASIC designed by Parallax. The processor can be programmed through USB port of host computer. The data from RFID reader is read by stamp processor. The allotted tag Id's are included in the written program and embedded in the processor. The processor checks the read RFID identity with stored ID. If the ID matches, it makes output to go to 1 state (5V DC) from zero state. This voltage operates a 5V relay. The contacts of this relay operate another 9V relay. The 9V relay operates the coil voltage 12V of contactor relay. The contactor relay switches 230V AC. The contact rating of contactor relay can be chosen of any value as per AC motor specification. The circuit diagram of the designed hardware is shown in Fig. 8 and the photograph of designed system is shown in fig. 9.



5. ADVANTAGES OF OUR SCHEME

In our designed system the doors of platform open only when the train has stopped at the station. It closes before the train starts again. So, there is no chance of a person jumping on the track. The persons cannot jump on railway track even when the train is not in the platform as the platform doors are closed for rest of time. The deaths of peoples by suicide at metro railway tracks and thus causing problem of regular services of metro railway can be avoided through our designed system.

Fig.9: Photograph of designed hardware

6. CONCLUSION

The initial cost of implementation of our designed system is little high but the necessity of the system cannot be avoided. The metro railway is a pride of Kolkata and of the whole nation as well. The cost of implementation of our system is negligible with respect to huge infrastructural cost of metro railway. Once installed, this system will help to minimize suicides at metro stations, the unwanted hazards due to these suicides and thus will help the metro authority to establish their superior service to the nation in a better way.

7. ACKNOWLEDGMENTS

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8. REFERENCES

[1] V. D. Hunt, A. Puglia, and M. Puglia, RFID:A Guide to Radio Frequency Identification: Wiley-Interscience, 2007.

[2] K. Domdouzis, B Kumar, and C. Anumba, "Radio Frequency Identification(RFID) applications: A brief introduction," Advanced Engineering Informatics, vol. 21, pp.350-355, 2007.

[3] Kuo-shien Huang and Shun-ming Tang, "RFID Application strategy and deployment in bike renting system", International conference on Advanced Technology, Vol 1, pp.660-663, Feb.2008.

[4] V. Chawla and D. S. Ha, "An overview of passive RFID," Communication Magzine, IEEE, vol.45, pp.11-17, 2007.

[5] Quan Z.Sheng, Xue Li and Sherali Zeadally, "Enabling Next Generation RFID Applications: Solutions and challenges", ,IEEECS, pp.21-28, Sep.2008.

[6] C.M.Roberts, "Radio Frequency Identification (RFID)",Computer and Security,vol.25, pp.18-26, 2006.