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RFID Based Neonatal and Nursery Care System

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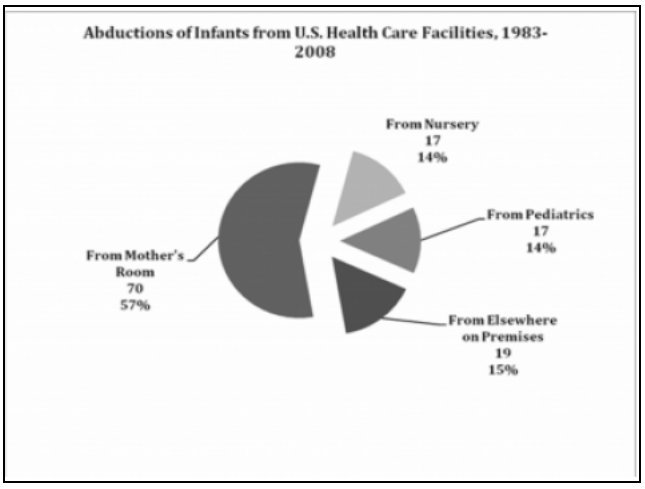
Abstract: One of the most prevalent problems in India is infants being abducted or getting mismatched from their respective parents. In a typical year we come across at least one case of a infant being mismatched or stolen. These are devastating events for the families involved and for the health care facilities staff and executives.

I. INTRODUCTION

A. The "Worst Nightmare"

The now is blooming with happiness on holding her daughter for the very first time. Her husband is downstairs clearing the medical bill and completing the insurance formalities. After a scheduled shift change a new nurse walks in and asks the mom to hand over the child to complete some necessary after birth tests in the nursery. She hands over the baby to the nurse, unknown to the fact that she won't be seeing her child again. When the husband comes back after 30 minutes they decide to visit the nursery to have to a look at their new born. When they arrive at the nursery they can spot three babies, but not their precious child. They rush to the nurse station and cannot find the new nurse either. The couple both blurt simultaneously to the nurse there "Where is our daughter?".

B. Baby Snatching



According to statistical data from the National Centre for Missing & Exploited Children (NCMEC) (2008) show that there have been 252 infants abducted in the United States over the past 25 years, with just under half of these kidnappings – 123 in all - taking place in the hospital environment. As can be seen in Figure 1, the scenario above is the most common type of in-hospital infant abduction.

Every year multiple new born are exchanged (Swapped) by mistake, or one out of every eight babies born in American Hospitals sent home with the wrong parent[1]According to a study out of 34 new-borns that are admitted to a neonatal intensive care unit there are 50% chances of incorrect new-born's identification only a single day[2].

In real applications, the biometrics traits that are commonly used in different authentication systems are the face, fingerprint, hand geometry, palm print, signature, iris, voice, etc. [3]. But most of these practical biometric systems are developed for adults only and may not be a solution with newborns RFID system is very effective in protection of the newborn in such hospitals. A special designed RFID tags attached with baby and his mother along with tag reader and automated system can manage the above issues.

The key advantages of such systems for health-care delivery may include [4]:

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1) Precise identification of objects without any physical contact or actual line of sight.
2) Sensors can also be integrated into RFID tags to record temperature or to spot positioning.
3) Data stored inside RFID tags can be encrypted, customized and made available as per need.
4) Tags are recyclable and can be made complex to imitation.
5) As a special device is required to read RFID tags and may not be human readable format increases.
6) Can be used to detect/track child/patients/medical equipment/expensive medicine

Bar Code Technology	RFID Technology
Bar Codes require line of sight to be read	RFID tags can be read or updated without the actual line of sight.
Bar Codes can be only read simultaneously	Multiple RFID tags can be read at one time.
Any damage to the bar code makes the tag unreadable	RFID tags are durable and are able to cope up in harsh and dirty environment as well.
Bar Code tags are not re-usable	RFID tag can be reused multiple times.
Must be manually tracked to access the data, making human error an issue.	Can be automatically tracked, eliminating the human error.

II. RFID BASED MOTHER INFANT IDENTIFICATION SYSTEM

The system in installed in the Neonatal Intensive Care Unit or in the Nursery and has following modules.

A. A RFID Band attached to the new born
B. A RFID Reader installed at all necessary points.
C. And a server to store all the necessary information.

The above proposed solution uses active RFID tag which have unique Identification number feeded into them. These RFID tags continuously send out signals or data packet which consists of the following information.

Data Field	Sample
Infant ID	IF_01
Mother ID	M_01_IF_01
Ward ID	W_01
Doctor ID	D_01
Nurse Assigned	N_01

As mentioned above the infant and mother ID have a relation with each other and if any discrepancy is found an alarm is raised. Also the only the doctor and nurses who have proper identification on them have access to the Neonatal or the Nursery room. The reader continuously receives information or data packet from the Wrist Band and keep track of the Infants, Mothers and the staff present in the respective room. This information is cross verified with the Database server in real time.



If the data from the server and the reader is mismatched then an alarm is raised and the necessary actions are taken. The system can be designed in such a way that when

a) The miscreant tries to cut the RFID tag an alarm is raised as well.
b) The miscreant tries to take the RFID tag out of the room to mishandle it the alarm is raised.

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The RFID tags will be designed in such a way that it will be waterproof having IP67 rating, it means Protected from immersion in water with a depth of up to 1 meter (or 3.3 feet) for up to 30 minutes. Also the tags will have a soft cushion so as it does not affect the skin of the infants and does cause an irritation on usage.

Using the RFID based Mother Infant Identification System any unauthorized or unwanted handling of the infant can be avoided. This also reduces the cases where the Infants were mismatched on birth, by verifying the data in the tag and server.

III. THE WARD CONTROL SYSTEM

In addition to the Mother-Infant identification system the Door Control System can be established in the Nursery room. According to D Wyld[5] In this system the RFID tags will be attached to the baby's anklets and to wrist of the mother. These two connected tags will continuously send signal to the receiver about their working status. In case either of the band stops working or gets damaged the receiver will promptly inform the system about it. The same system can be connected to main door. The system is set to raise an alarm if the RFID tag is tried to be removed from the baby's leg, without informing the system admin first. Similarly the main door of the children's ward can be designed in such a way that it locks itself down when the alarm is raised. This can prevent the child thief from escaping with the baby.

Another feature in the system is that when a baby is taken for a check-up for a long period of time and is brought back to the mother, there are chances that the baby is mismatched with another similar looking babies present in the ward. Hence to avoid this when the baby is brought near to the correct mother the both RFID tags send a signal to the system that the mother and the infant are correctly matched and there is no need to sound an alarm. In case due to human error a baby is mismatched with its mother, the system will send an alert to the operator and within no time the baby can be matched with its real mother, by checking into the system.

The Ward Control System could also stop the phenomena of "Leaving without proper discharge", where the mother and the new born would simply disappear before being properly discharged and also without clearing the hospital bills.

According to Jebb Nucci, RFID ProSolutions' Vice President of RFID: "Both [of the French] hospitals had experienced a high level of mothers and babies who would leave the ward before being properly discharged," Nucci explains. "This was a major problem for nurses, because they would spend so much time looking for mothers and babies that were already gone. With the system in place, a mother and her baby must go see the nurses before leaving so they can deactivate and remove the baby's tag to avoid sounding the alert on their way out" (Bacheldor, 2008, n.p.).

The ward control system using RFID can be used monitor that the correct medicines and injections that are given to the mother and infants. The hospital has a inventory management system where every injection or medicine inventory stock is managed using RFID which also prevents thefts and misuse. Similarly this system can be used to keep a track that correct medicine and injections are given to the mother/infants.

According to a recent study by Johns Hopkins, more than 250,000 people in the

United States die every year because of medical mistakes, making it the third leading cause of death after heart disease and cancer. Considering this figure it is utmost necessary to administer correct medicine to the said patient. Using RFID ward control system every Injection or the Medicine Container will have an RFID tag attached to it. The nurse while administrating the injection or dosage to the infant/mother can scan the RFID tag with the scanner. The scanned value will be compared with the prescription that the doctor has stored in the database and the nurse will know that there is no medicinal error. The nurse can use a handheld RFID reader it can scan the tag on the Infants leg as well on the Mothers wrist this data will be compared by reading the barcode present on the medicine or injection.

IV. CONCLUSION

Although the cost per system might be high but it all takes a single case of kidnaping to devastate the family involved and also to ruin the hospitals reputation as well. Similarly giving the wrong medicine to a pregnant woman or to an infant can be deadly. With the cases of child thefts increasing in India it the dire need of the moment to install such a system in every government hospital to prevent such accidents. The ward control can be implemented similarly into other wards of the hospital.

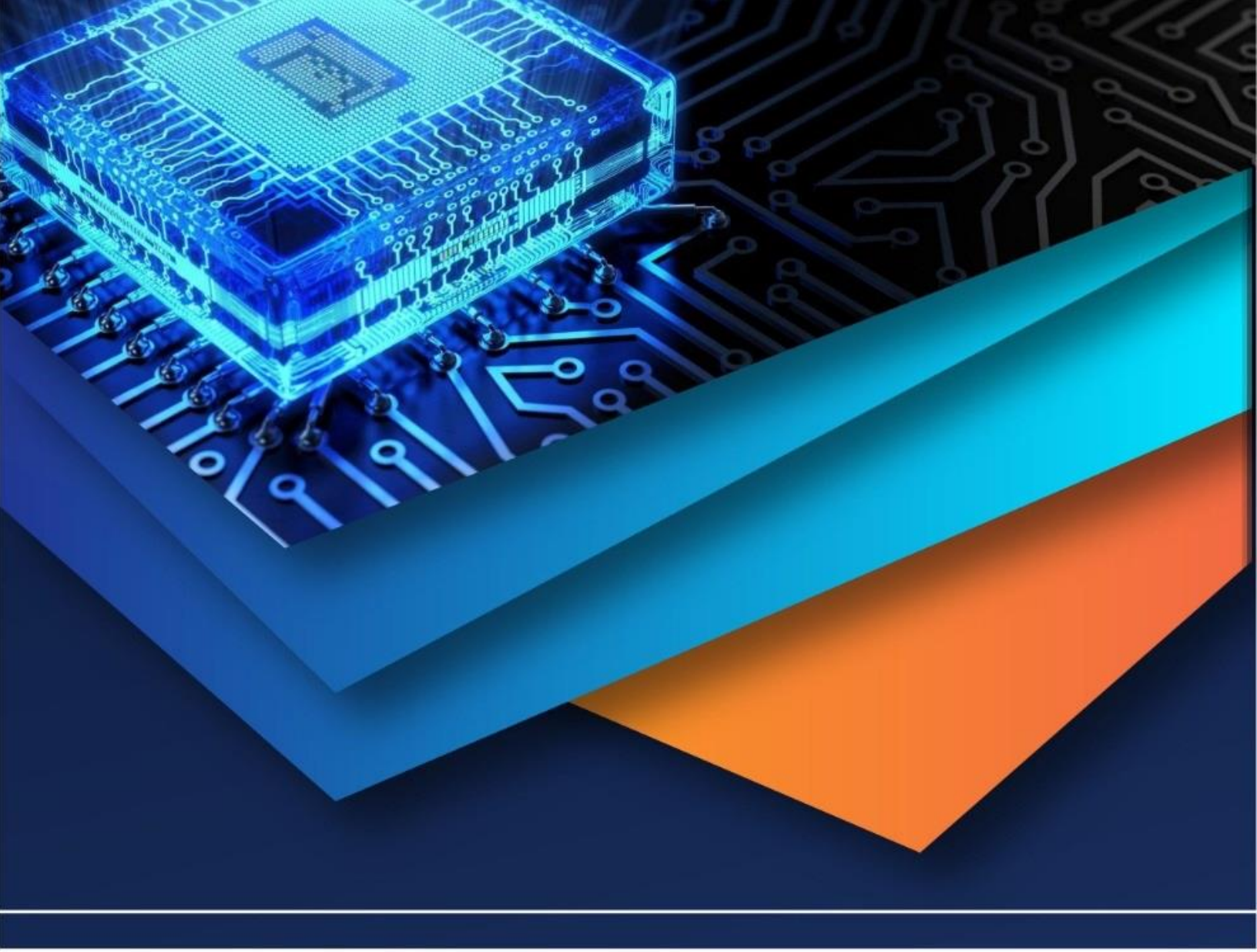
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