Implementation of Near Field Communication (NFC) system using ARM

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Abstract- NFC is a technology used for contactless short-range communication. Active RFID transponders [reader/writer devices (RWDs)] for NFC applications are basically built up with common 13.56-MHz RFID readers with supported data rate 106,212-424 Kbit/s. NFC is designed to be a secure form of data exchange, and an NFC device is capable of being both an NFC reader and an NFC tag. This unique feature allows NFC devices to communicate peer-to-peer.The proposed NFC system comprises NFC reader, NFC tag and antenna. The system is built using STM32F4DISCOVERY high-performance discovery board and NFC system communicating with each other using serial communication. NFC-enabled communicates via magnetic field induction, where two loop antennas are located within each other's near field, effectively forming an air-core transformer. A signal supplier coupled to the antenna circuit to supply a drive signal to cause the antenna circuit to generate an RF signal.

Keywords – Near Field Communication (NFC), ARM, NFC system, NFC tag, STM32F4DISCOVERY board

I. INTRODUCTION

The proposed system is based on the communication between NFC reader and ARM which is used as the platform for different NFC based applications. The number of short-range applications for NFC technology is growing con-tenuously, appearing in all areas of life. Especially the use in conjunction with mobile phones offers great opportunities. Up to now the convenience of NFC is mostly used in Asia, for instance in Japan or South Korea, where paying with a mobile phone or a NFC-smartcard already belongs to everyday life.

This system is built using STM32F4DISCOVERY high-performance discovery board and NFC reader communicating with each other using serial communication. NFC is a technology for contactless short-range communication. Active RFID transponders [reader/writer devices (RWDs)] for NFC applications are basically built up with common 13.56-MHz RFID readers with supported data rate 106,212-424 Kbit/s. NFC-enabled communicates via magnetic field induction, where two loop antennas are located within each other's near field, effectively forming an air-core transformer. A signal supplier coupled to the antenna circuit to supply a drive signal to cause the antenna circuit to generate an RF signal. When tag enters in the range of antenna field it transfer the data stored in the memory of tag to NFC reader. This data is identification number of NFC tag. Some tags having more memory, they contain the information related to the application. The main applications are as a tourist-guide in museum, payment & ticketing, electronic keys, identification, receive and share information & set-up service. Up to now the convenience of NFC is mostly used in Asia, for instance in Japan or South Korea, where paying with a mobile phone or a NFC-smartcard already belongs to everyday life. NFC can be used for the set-up of other longer-range wireless technologies, such as Bluetooth or Wireless LAN.

II. NEAR FIELD COMMUNICATION(NFC)

NFC is designed to support existing RFID transactions including contactless payment and some ticketing systems, as well as being a generally programmable platform. This technology, among the different sectors in which it is applied, is also integrated in smartphones. It originates from the evolution of studies and researches in the RFID field, or Radio Frequency Identification. It ranks among the technologies of automatic identification of people, animals and objects, proving to be very important in areas such as logistics, distribution and services. The two technologies, NFC and RFID, have much in common, but one of the main differences between them is demonstrated by the antenna design. Moreover, that the arrangement for the data exchange is no longer a card reader or a typical RFID but a Smartphone, is another outstanding element. The NFC Forum (a no-profit organization founded in 2004 by Philips,

Nokia and Sony) developed a highly stable framework for the development of applications, interoperable seamless solutions and safe transactions. The NFC Forum has also coordinated the work of lots of organizations through the creation of committees and working groups.

Near-field communication (NFC) devices, which are derived from radio frequency identification systems (RFID). Near Field Communication (NFC) is a standards-based, short-range wireless connectivity technology that enables simple and safe two-way interactions between electronic devices. It allows consumers to perform contactless transactions, access digital content, and connect electronic devices with a single touch. To make their use even more convenient, they shall always stay activated and scan the environment for passive communication partners. When they come in contact with passive communication partners, provides data exchange across distances up to 10 centimeters.

NFC operates in three different modes. Each of these modes requires that NFC devices use a common data format for communications

1. Reader/Writer (R/W) Mode

2. Peer-to-Peer (P2P) Mode

3. NFC Card Emulation (NCE) Mode

Because the transmission range is so short, NFC-enabled transactions are inherently secure.

III. HOW SYSTEMS WORKS

This proposed system contains NFC device & NFC tag.NFC device includes NFC reader and STM32F407VGT6 microcontroller

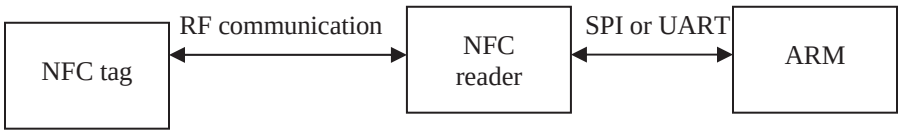

Figure1. Block diagram of system

When a tag enters in the range of NFC reader's antenna, NFC reader supplies power to tag. As NFC reader works in read mode it continuously burst the RF field. When tag enters in RF field it reads information stored in NFC tag. This information is the identification number of NFC tag. NFC reader sends this information to ARM. NFC reader communicates with ARM using serial communication protocol(SPI or UART). The function of a passive Radio Frequency Identification System can be described in its simplest form as an RFID reader identifying an RFID tag, reading data from the tag and writing data to the tag - without contact or line of sight. In the 13 MHz area inductively coupled systems where the necessary energy is provided by the magnetic field of the reader. The actual functionality of 13.56 MHz RFID systems is based on resonant circuits (tuned to 13.56 MHz) on reader and tag side to generate sufficient voltage and power.

A. STM32F4Discovery Board-

This board is built with STM32F407VGT6 microcontroller featuring 32-bit ARM Cortex-M4F core with onboard ST- LINK/V2. Two push buttons (user and reset) are used for switching of the operations. The tag hunting function is used to communicate with NFC reader. This ARM is used as data provider between NFC reader and the application implemented on the system platform.

B. CR95HF- NFC reader-

The CR95HF is an integrated transceiver IC for contactless applications. The CR95HF manages frame coding and decoding in reader mode for near field communication (NFC). The CR95HF embeds an Analog Front End to provide the 13.56 MHz Air Interface. The CR95HF also supports the detection, reading and writing of NFC tags.

Active mode includes two steps

i) Ready: In this the RF is OFF and the CR95HF waits for a command from the external host via the selected serial interface (UART or SPI)..

ii) Reader: The CR95HF can communicate with a tag using the selected protocol or with an external host using the selected serial interface (UART or SPI).

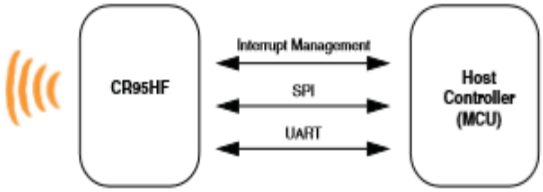

Figure2. Communication between NFC reader & ARM

C. Communication Protocol: Serial peripheral interface -

In order to send commands and receive replies, the application software has to perform 3 steps.

1. Send the command to the CR95HF.

2. Poll the CR95HF until it is ready to transmit the response.

3. Read the response.

The application software should never read data from the CR95HF without being sure that the CR95HF is ready to send the response. After initialisation of CR95HF, ARM sends command to reader to select the protocol for RF communication. There is no separate command for 'Field ON'. When the application selects an ISO14443A RF communication protocol, the field automatically switches on. When the application selects a protocol, the CR95HF performs all necessary settings: it will choose the appropriate reception and transmission chains, switch ON or OFF the RF field and connect the antenna accordingly.

D. Tag detection & identification-

NFC tags are designed just like an RFID tag to be used at 13.56 MHz and therefore the tag design is similar. At this frequency range, RFID tags mostly use the theory of Strongly Coupled Magnetic Resonance. This is basically where two nearby loop antennae provide strong electromagnetic mutual induction resonance. This effect is also known as inductive coupling. During operation, other communication frequencies are disabled which allows very fast communication between coupled resonances. This phenomenon is valid only for loop antennae that are placed very near to each other.

E. *Flowchart of system*-

TAG HUNTING is the function used to implement serial communication between ARM & NFC reader. After communication starts NFC will continuously burst the RF field to detect a TAG is entered in its RF field or not.

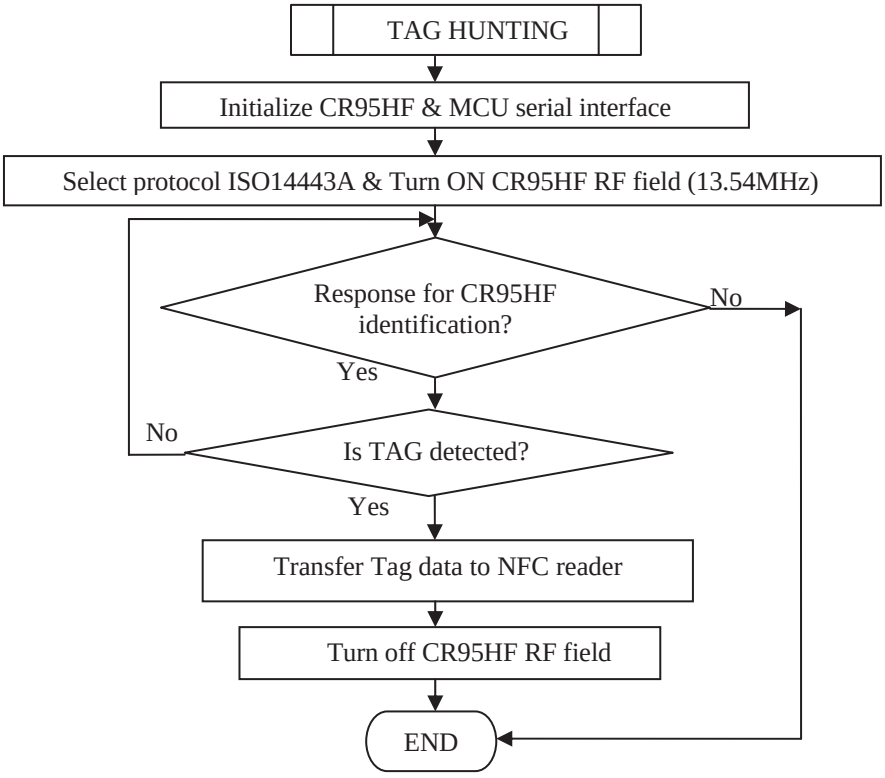

Figure3. Flowchart of the system

IV.CONCLUSION

The described platform offers the basic features of an system for the delivery of personalized contents. However, the whole project is based on a communication between NFC and ARM, which may be the foundation of an integrated system of applications such as Tourism and Culture. In the future a holistic vision of history, tradition and culture will be available to the visitors, who will be able to easily plan all the details about their visits to museums, theatres, historical sites, monuments, and tourist attractions in general. Connectivity distance is less than 10 centimeters and it brings inherent security. Integration of NFC technology with mobile phones which consists of mobility, relatively high processing power, Internet access ability etc. has a great potential to bring new opportunities to our lives. Furthermore, due to the short distance communication occurs so quickly. It is a more secure technology than RFID and Bluetooth due to its frequency and short distance specifications. NFC is an evolved from of RFID but its applications are run similar to Bluetooth. The many benefits and potential uses of NFC technology will continue to drive the technology and push innovation in the application fields.

REFERENCES

[1] Haselsteiner, E.; Breitfuß, K. Security in near field communication (NFC). In Proceedings of the Workshop on RFID Security, Graz, Austria, 12–14 July 2006; pp. 12–14.

[2] Madlmayr, G.; Langer, J.; Scharinger, J. Managing an NFC ecosystem. In Proceedings of the 7th International Conference on Mobile Business, 2008 , Barcelona, Spain, 7– 8 July 2008; pp. 95–101.

[3] Agrawal, P.; Bhuraria, S. Near Field Communication. SETLabs Breifings 2012, 10, 67–74.

[4] D. Aamoth, "How the New Google Wallet Mobile Payment System Works," Time Magazine Techland, 2011.

[5] Ernst Haselsteiner and Klemens Breitfuß Security in Near Field Communication (NFC) *Strengths and. Weaknesses* Philips Semiconductors Mikronweg 1, 8101 Gratkorn, Austria

[6] Hongwei Du NFC Technology: Today and Tomorrow International Journal of Future Computer and Communication, Vol. 2, No. 4, August 2013 351

[7] Trends Gabriella Arcese , Giuseppe Campagna , Serena Flammini and Olimpia Martucci Near Field Communication: Technology and Market Department of Business Studies, Roma Tre University, Rome, Italy; Technologies 2014, 2, 143-163;

[8] Joan, B. "Difference Between RFID and NFC".)

[9] Busra Ozdenizci, Mohammed Alsadi, Kerem Ok, and Vedat Coskun Classification of NFC Applications in Diverse Service Domains International Journal of Computer and Communication Engineering, Vol. 2, No. 5, Sept 2013

[10] K.Preethi1, Anjali Sinha2,Nandini3 Contactless Communication through Near Field Communication International Journal of Computer and Communication Engineering Volume 2, Issue 4, April 2012

[11] Touch and Run with Near Field Communication (NFC) en Dodson Hristo Bojinov Monica S.Lam Computer Science Department Stanford University

[12] High Speed RFID/NFC at the Frequency of 13.56 MHz C. Patauner1, H. Witschnig1, D. Rinner2, A. Maier3, E. Merlin1, E. Leitgeb2 1NXP Semiconductors Mikronweg 1, 8101 Gratkorn, Austria

[13] ”Near Field Communication in Cell Phones” Annika Paus 24.07.2007 Seminararbeit Ruhr-Universit¨at Bochum

[14] Near Field Communication (NFC) By: Zafar Ullah, Field Applications Engineer, Arrow Electronics, and Floyd Goodrich, Regional Technical Manager, Arrow Electronics.

[15] Near Field Communication Its Applications and Implementation BY: Mohammad Umair YaqubKing Fahd University of Petroleum & Minerals

[16] Clark, S. Museum of London Adds NFC. 2011. Available online:http://www.nfcworld.com/ 2011/08/16/ 39129/museum-of-london-adds-nfc/ (April 2014).

[17] Ceipidor, U.B.; Medaglia, C.M.; Volpi, V.; Moroni, A.; Sposato, S.; Carboni, M.; Caridi, A. NFC technology applied to touristic-cultural field: A case study on an Italian museum. In Proceedings of the 2013 5th International Workshop on Near Field Communication (NFC), Zürich, Switzerland, 5 February 2013; pp. 1–6.