DEVELOPING A SOFTWARE:
NEGATIVE SYMPTOMS OBSERVED ON SCHIZOPHRENIC PATIENTS CURED IN
HOSPITAL WITH RFID TECHNOLOGY

Adnan Fatih Kocamaz, Erdem Uçar

ABSTRACT: Identification is a powerful capability, useful in classifying, counting, and organizing objects. These operations are essential to many aspects of modern life, including manufacturing, the logistics of distribution, and the various stages of supply chains, and they operate on scales ranging from the level of the individual consumer to that of global trade.

Radio frequency identification (RFID) is a means of identifying objects by interrogating a unique characteristic of the object (such as a unique identifying number stored on a silicon chip attached to the object) using radio waves. This technology promises orders-of-magnitude greater efficiency and accuracy than were possible with previous technologies [1].

This paper investigates the negative symptoms observed on schizophrenic patients cured in hospital with RFID technology with developing software. We endeavor to provide answers to many questions concerning the effects of mobility and drug usage on schizophrenic patients using the RFID remote description method. Our aim is to develop a new assistive technology, to cure schizophrenic person. This paper partially reports on a project being developed by the Department of Computer Engineering and the Department of Psychiatry, Trakya University. And the paper investigates how we develop the software and what we make along developing software.

Key words: developing RFID software, schizophrenia, Auto ID systems, negative symptoms, positive symptoms, drug side effects.

Introduction

To understand RFID technology characteristics one must first understand just what is RFID. RFID (Radio Frequency Identification) is a means of storing and retrieving data through electromagnetic transmission to an RF compatible integrated circuit [8].

Certainly, there are several identification types; bar codes, finger prints, thermal identification, password, etc. but advantage of RFID identification is non-contactless technology. At this technology, person, who is tried to identify, doesn’t have to contact anything.

Radio Frequency Identification (RFID) is the quintessential Pervasive Computing technology. The last of this century, mobile and wireless application is started to prefer.

Introduction to RFID

RFID is an area of automatic identification that is gaining momentum and is considered by some to emerge as one of the most pervasive computing technologies in history. In its simplest form, RFID is a similar concept to bar coding. It is seen as a means of enhancing data processes and is complementary to existing technologies. It is a proven technology that has been in use since the 1970s [4].

RFID is used for a wide variety of applications ranging from the familiar building access control proximity cards to supply chain tracking, toll collection, vehicle parking access control, retail stock management, ski lift access, tracking library books, theft prevention, vehicle immobilizer systems and railway rolling stock identification and movement tracking [4].

Basis of RFID

One of the earliest papers exploring RFID is a landmark paper by Harry Stockman “Communication by Means of Reflected Power” published in 1948. This came on the heels of the radar and radio research undertaken during the Second World War [4].
A typical RFID system can use the principle of modulated backscatter (see Fig. 1). In this type of RFID system, to transfer data from the tag to the reader, the reader sends an unmodulated signal to the tag. The tag reads its internal memory of stored data and changes the loading on the tag antenna in a coded manner corresponding to the stored data. The signal reflected from the tag is thus modulated with this coded information [5].

![Fig. 1](image1.png)

**Fig. 1** Functional blocks for reading data from a backscatter RFID tag. The reader is on the left, and the tag is on the right [5].

**Backscatter Modulation Theory**

Modulated backscatter technology allows readers to communicate with tagged objects traveling in excess of the normally specified 100 miles per hour (160 kilometers per hour). This technology can also operate from as far away as 100 feet (30.5 meters).

This highly stable, reliable, and reflective method of wireless reader-to-tag communications is the transportation industry's premier method of automatic equipment and vehicle identification.

Key reasons for using reflective, or passive, tags over traditional transmitter or "active" tags include:

- Because the tag simply reflects the reader's signal, there are no frequencies to synchronize, and interference from other radio frequency sources is rare.
- Frequency changes can be made in the reader, eliminating tag recall.

Reflective tags require less internal power than traditional transmitter tags so they have a longer life. They also have greater range than bar code, infrared, or other passive systems [6].

This terminology refers to the communication method used by a passive RFID tag to send data back to the reader. By repeatedly shunting the tag coil through a transistor, the tag can cause slight fluctuations in the reader’s RF carrier amplitude. The RF link behaves essentially as a transformer; as the secondary winding (tag coil) is momentarily shunted, the primary winding (reader coil) experiences a momentary voltage drop. The reader must peak-detect this data at about 60 dB down (about 100 mV riding on a 100V sine wave) as shown in Figure 2 [7].

![Fig. 2](image2.png)

**Fig. 2**: amplitude – modulated backscattering signal

**Types of RFID Tags**

There are two types of RFID tags, this are passive and active tags. Passive tags have not a battery. These tags provide the energy from readers' electromagnetic transmission.

But the active tags have a battery for supply energy. Active tags (fig. 3) can be read farther than passive tags. VeriChips based on passive tags principle.

**RFID Architecture**

The RFID system architecture consists of a reader and a tag (also known as label or chip). The reader queries the tag, obtains information, and then takes action based on that information.

![Fig. 3](image3.png)

**Fig. 3** Active RFID tag

**Passive RFID tags**

Passive RFID tags do not contain a battery or other power source; therefore, they must wait for a signal from a reader. The tag contains a resonant circuit capable of absorbing power from the reader’s antenna. Obtaining power from the reader device is done using an electromagnetic property
known as the Near Field. As the name implies, the device must be relatively near the reader in order to work. The Near Field briefly supplies enough power to the tag so that it can send a response [9].

**Reader**

Usually a microcontroller-based unit with a wound output coil, peak detector hardware, comparators, and firmware designed to transmit energy to a tag and read information back from it by detecting the backscatter modulation.

**Tag**

An RFID device incorporating a silicon memory chip (usually with on-board rectification bridge and other RF front-end devices), a wound or printed input/output coil, and (at lower frequencies) a tuning capacitor (fig. 4).

The RF field generated by a tag reader (the energy transmitter) has three purposes:

1. **Induce enough power into the tag coil to energize the tag.** Passive tags have no battery or other power source; they must derive all power for operation from the reader field.

2. **Provide a synchronized clock source to the tag.**

3. **Act as a carrier for return data from the tag.** Backscatter modulation requires the reader to peak-detect the tag's modulation of the reader's own carrier.

<table>
<thead>
<tr>
<th>Frequency Band</th>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>125-134 KHz</td>
<td>Low frequency</td>
<td>To 18 inches</td>
</tr>
<tr>
<td>13.553-13.567 MHz</td>
<td>High frequency</td>
<td>3-10 feet</td>
</tr>
<tr>
<td>400-1000 MHz</td>
<td>Ultra High frequency</td>
<td>10-30 feet</td>
</tr>
<tr>
<td>2.45 GHz</td>
<td>Microwave</td>
<td>10+feet</td>
</tr>
</tbody>
</table>

**Table 1 RFID reader distance range.**

Most RFID systems can simultaneously capture data from many tags within range of the antenna. Some are capable of capturing tag identification codes at a rate of up to 1,000 tags per second. The reading distance range of the reader depends on the number of antennas used, antenna size, and frequency (Table 1) [10].

**Near Field**

There are only two possible physics concepts used by RFID Technology for the detection of RFID Tags. They are: Near Field Concept (Magnetic Coupling) (fig. 5) and Far Field Concept [8].

The Near Field is a phenomenon that occurs in a radio transmission, where the magnetic portion of the electromagnetic field is strong enough to induce an electrical field in a coil. As the name implies, the Near Field occurs in an area near to the antenna.

\[ r = \frac{\lambda}{2 \pi} \quad (1) \]

where \( \lambda \) is the wavelength.

For example, a common RFID frequency is 13.56 MHz and the wavelength of 13.56 MHz is approximately 22 meters. Therefore:

\[ \frac{22}{2 \pi} = \frac{22}{6.28} = 3.5 \text{ meters}. \quad (2) \]

The Near Field for an RFID device operating at 13.56 MHz is 3.5 meters or 11.5 feet. Passive tags requiring the Near Field, have to be within that area in order to operate correctly [11].

![Components of a passive RFID tag.](image)
3. BASIS OF THE PROJECT

Schizophrenia occurs that hallucination, perception irregularity, disorganize speech, and disorganize catatonic behaviour and negative symptoms. So it is not a homogeneity disease, it is accepted as spectrum irregularity. However, the irregularity standards are declared in DSM classification, some symptoms that have to be measured objectively is difficult. Hallucination, perception irregularity, disorganizes speech, and disorganizes catatonic behaviour which is in the DSM classification, is the positive symptoms. And the negative symptoms are affectivity difficulty, aloji (speech difficulty), avulsion (not to do stopping and starting aim tendency activity, if it is harder he cannot make own work, take care itself, mental occupations), social introverting and claim decreasing. Positive symptoms can be defined over deviation normal behaviour and negative symptoms can be defined reduction deviation normal behaviour.

The primary aim of this software appreciates negative symptoms observed on schizophrenic patients cured in hospital with RFID technology, and compare to its consistence. So we try to determine whether RFID applications are an objective measuring and evolution method in schizophrenia.

As the side effects of antipsychotic medicines used on the schizophrenia patients, extrapramidal and metabolic side affects appear. Side effects that defined extrapramidal, includes mobility and daily activity decrement effects like Parkinson. At these patients, metabolic side effects are appeared because of decreased daily activity and antipsychotic medicines effects of growing fat. Therefore, measuring and evaluating daily activity of psychiatric patients is important for medication and evaluating functionality.

This working is also important to find side effects of medicines that use for schizophrenia patients. And whether RFID technologies benefit this, will be researched.

Research possibilities

The research continues Department of Psychiatry of Trakya University couchant patient service. This department can service 30 patients at the same time.

Placing the tags on a patient

We put into the tags two stiff plastic cards which shown at figure 6. The patients carry this tags fronts.

When a patient who carry the tag, passes front of a reader antennas, the RFID reader reads the tag code which we load before.

Unreadable tags positions

We explore that sometimes the reader doesn’t read the tags.

There are some unreadable positions;

1- If the tag doesn’t see the reader’s antennas directly, sometimes it couldn’t be read.
2- If the patient take the tag to hand,
3- Some tags have less reading quality at the production.
4- Sometimes antennas containment area can be wrong.
5- Sometimes the patient can throw the tag.

We experience like these positions can’t allow reading. So we develop some ideas about software and system configuration. Some of them are;

1- We try to dress new uniform which have got 4 tags that put in the uniform. One of them is at the right shoulder and second one is at the left shoulder, third one is in front, and the last one is at the back. So, the reader can read tags every situation.
2- If we dress the patient can’t take it hand.
3- We choose ALIEN UHF tags because of reading distance are %33 higher then the other UHF tags.
4- We regulate the antennas position after we set up the system.

These corrections are for hardware and we try to decrease the reading faults on software. For
example; If a reader read the tag when a patient across a antennas, the second antennas don’t read the tag. And the third antennas read the tag again. We describe in the software all the antenna’s distance between each other. so, if a tag isn’t be read by a reader antennas and read by the other, the software can measure the mobility distance of the patient. Sample antennas distance combinations table is shown at table 2.

### Table 2 Sample antennas distance combinations

<table>
<thead>
<tr>
<th>Reauders and tags technical specifications</th>
<th>Antennas distance combinations</th>
<th>distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antenna 1 – antenna 2</td>
<td>7 m</td>
<td></td>
</tr>
<tr>
<td>Antenna 1 – antenna 3</td>
<td>14 m</td>
<td></td>
</tr>
<tr>
<td>Antenna 1 – antenna 4</td>
<td>21 m</td>
<td></td>
</tr>
<tr>
<td>Antenna 2 – antenna 3</td>
<td>7 m</td>
<td></td>
</tr>
<tr>
<td>Antenna 2 – antenna 4</td>
<td>14 m</td>
<td></td>
</tr>
<tr>
<td>Antenna 3 – antenna 4</td>
<td>7 m</td>
<td></td>
</tr>
<tr>
<td>Antenna 3 – antenna 5</td>
<td>14 m</td>
<td></td>
</tr>
</tbody>
</table>

At this project, ALIEN UHF “long range” RFID readers are used. Alien ALR-8800 Enterprise RFID reader is the best reader at the category. It support “simple network management” so we can reach its specification and change on network. And it supports the last version of 2. generation RFID protocol [12]. Every reader includes 4 RFID antennas inputs, but we can use every two input for one receiver. So antenna 1 is only receiver 1 and antenna 2 is only transmitter 1 and antennas 3 is only receiver 2 and antennas 4 is only transmitter 2. It has shown figure 7.

We used different tags in the project but ALIEN GEN 2 SQUIGGLE passive RFID tags have got %33 more readable rates. The tag is EPC class 1 generation 2.

We choose UHF RFID readers and tags because of distance range. The other RFID reader models cannot be enough for this application. Because

The plan of the department is given at figure 8. And also is given RFID readers and Antennas place on the plan. The department include two corridors. But we put our 5 RFID readers only one corridor.

We placed readers and antennas like figure 7. And we describe readers and antennas in our software. There is 7 meter between every receiver and transmitter antennas. And we placed the antennas under every colon. And we can describe the distance between every antenna in our program.

The READER 3 is different the others because of it is on the rest area. All the readers measure distance of between the antennas but this reader measures time that how long patient rests.

Fig. 8 Plan of Psychiatry Department and RFID readers’ and antennas’ placement

### Defining Algorithm of the Software

Developed software has got the following parts:

1. **Processes**
   - Start operation
2. **Operation process**
   - Movement list
3. **Descriptions**
   - Defining patients info
   - Coupling patients and RFID tags
   - Departments
4. **Management**
   - System descriptions
   - Management descriptions
   - Groups
   - users
   - Readers
   - Reading points
   - Locations
   - Location differences
   - Data base backup
5. **Reports**
   - Patients tag list
   - Cured patients list
• Patient movement list
• Patient walking distance list

The parts of software describes in this section.

Processes
This section starts and stops to the reading operation.

Operation process
In this section, when the operation start, the tags unique number and patients name which is read from antennas, adds this list. At the same time we can see online in this list the time and date and location of the patient.

Descriptions
Defining Patients info
Patient’s info can be defined in software. Patient name, surname, telephone numbers and parent’s can be entered the program. It can be seem figure 9. All the patients who will be followed, info have to enter the system because of coupling patients name and RFID tags number. Every tag has to couple only one patient. If a patient leaves from department, patient tag’s validity is finished by the user, but patient’s mobility info stay in the data base. So we can use the same tag for another patient.

Coupling patients and RFID tags
After the patient info enters the data base, the patients have to coupling with the RFID tag number. Every RFID tag has got a unique number. If two tags have got the same number, the program will give an error message. We can load this unique number to tag with a USB RFID tag loader. Coupling process’s phases are given below:
1- RFID tag put on the USB loader
2- Button “oku” (read) must be clicked, and then the unique number seems on the text box which is shown figure 10.
3- The patient name select from list.
4- Date of the coming to the department must be selected

Management
Describing Users and groups
We describe users to reach program data. User ID and password can be given. And we can make some working group in this section.

Defining readers and antennas
Readers can be defined very easy in program. Every reader must be introduced the software. Every reader has got an Ethernet port. All the readers are connected to each other and control PC via the switch hub. It is seemed at fig. 8. So, if developers want to append a new reader, they just set up reader and connect it to switch hub. And it is easy to append new reader to software.
To define readers only add the IP address to the defining reader’s part of the software.
All the readers’ descriptions are given table 3.

Table 3 reader’s descriptions

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>IP add</th>
<th>User name</th>
<th>Password</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reader1</td>
<td>Entrance</td>
<td>192.168.29.10</td>
<td>alien</td>
<td>xxx</td>
</tr>
<tr>
<td>Reader2</td>
<td>Corridor 1</td>
<td>29.20</td>
<td>alien</td>
<td>xxx</td>
</tr>
<tr>
<td>Reader3</td>
<td>Corridor 2</td>
<td>29.30</td>
<td>alien</td>
<td>xxx</td>
</tr>
<tr>
<td>Reader4</td>
<td>Corrid. end</td>
<td>29.40</td>
<td>alien</td>
<td>xxx</td>
</tr>
<tr>
<td>Reader5</td>
<td>Rest area</td>
<td>29.50</td>
<td>alien</td>
<td>xxx</td>
</tr>
</tbody>
</table>

Reading points, locations and location differences
After we describe the readers we have to describe reading points. In this section, user groups the reader antennas and user choices suitable locations to every antennas group. We can choose every antenna for one location on the section. It is shown at figure 10.
So we have to determine locations before describing reading points. Every antennas group must have a location.
And about location difference, it is told 3.2.1 Unreadable tags positions and given an example at table 2.
This section is the most important section of the program. User can query all movement distance of a patients here. Every kind of query can be taken. We can select patient name and movement date and time interval. For example; we can query to a patient movement list for one day, for one week, for in a day between two times. The system is turn on at a.m. 8:30 every day and turn off at p.m. 5:00. And then the doctors can take movement results, and will make statistical working which told “basis of the project”. One sample is given at figure 11 (a) – (b).

(a) An inquiry sample from reports section

**HASTA YÜRÜME MESAFESİ LISTESİ**

Pazartesi, Haziran 30, 2008 16:37:24

<table>
<thead>
<tr>
<th>Hasta Kodu</th>
<th>Hasta Adı Soyadı</th>
<th>Toplam Alınan Mesafe</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>april</td>
<td>301 metre</td>
</tr>
<tr>
<td>2</td>
<td>maymun</td>
<td>363 metre</td>
</tr>
<tr>
<td>3</td>
<td>maymunkin</td>
<td>437 metre</td>
</tr>
<tr>
<td>4</td>
<td>ladjie peloto</td>
<td>42 metre</td>
</tr>
<tr>
<td>5</td>
<td>Salkiköçük</td>
<td>0 meter</td>
</tr>
</tbody>
</table>

(b) An inquiry result sample

**Fig. 11 (a) - (b) an inquiry and results**

**Conclusion**

After the reports results will be taken, we can explain that things and the doctors of the psychiatry will make statistical works and try to find some questions answer given below;

1- How much meter does a patient walk in a day?
2- Is there any affects of medicines to movement range?
3- Can we discover a pattern between schizophrenic and movement distance?
4- Which hours of a day, does a schizophrenic patient walk mostly and less meters? And can we use this info?

And after we start to take the results, we try to find another questions and answer.

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