

RESEARCH AND DEVELOPMENT OF BLUETOOTH LOW ENERGY ENABLED SMART MEDI CAPSULE

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Abstract

In our olden days the population is less and also, because of their healthy habits and good environmental conditions they were less prone to diseases. But day by day in our Indian population the number of patients that were suffering from different diseases is increasing. For those diseases the valuable medicine were discovering by researchers and scientists. But by taking the advantage of the human weakness about their health some of the companies were introducing fake medicines into the market with least cost and also sometimes duplicating the original medicine names. So, that because of those illegal and improper medicine usages causes the patients to lose their valuable lives. In some cases there may not be any expiry date. For this reason also there may be a chance of getting negative results with side effects. Another issue is in olden days because of illiteracy they are not interested to know about their medication. Later by 20th century situation has changed. Due to the drastic increase in literature people are interested to know more details about their medication.

As one of the solution to this we introduce a new method of placing a Bluetooth module on the medicine bottle and the entire information about the medicine along with manufactured date and expiry date and about manufacturer that whether the manufacturer has certified under regulators etc... will be presented to the consumer through an android interface. This proposed system can be used to send feedback to the manufacturer and also it can be used to set reminder to take particular dosage of particular medicine for particular interval of time.

Keywords: Medicine bottle, Medicine Details, Fake Medicine control, Bluetooth, Smart Phone, Reminder, Android and App.

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1. INTRODUCTION

In olden days people depends less on medicines prepared by pharmacies as they depend more on natural herbs and the ayurvedic medicines. Later slowly situation has changed because of increase in literature and research area new powerful medicines were invented for the epidemic diseases. As these medicines were fast to react with body and fight with disease causing germs people got more belief on medicines prepared by scientists. By there, usage of medicines has increased gradually even for small diseases. At starting stages i.e., dates from 1600 pharmacists used glass bottles for storage as they are inactive to medicine in the bottle than ceramic containers. There was connection between the color of the bottle and contents in the bottle. They used Blue color bottle to indicate it as poison. By 1800's Green become more common. Blue color is also used for syrup. Green and blue share similar contents. Their contents were more likely to be dangerous containing poisons and acid. Then for tablets different indication colors and drugs were used to attract children to make them more willing to take. But research had proved that it is carcinogenic for certain colorings. So, certain colors have banned.

In 1800's mainly illiterate society recognized bottles containing poison by using their color. Again color labels were also used. A red color label with printed in black was used to represent poison and red ink on white was for external use only. In 1899 Legislation made the use of special poison bottles compulsory. By 1935 they decided to make poison bottles recognizable to the touch would avoid situations of accidental intake of poison.

As the literature rate has been increasing people understood importance of labeling on medicines. So, it was made compulsory to attest label on the medicine bottle. But not only just labeling but it is important to provide proper information to the consumer to protect themselves from wrong consumption of medicine.

As the medical awareness has been increasing people were interested to know more details about their medication.

Apart from this illegally manufactured, uncertified, expired and fake medicines are entering into the market. Because of the consumption of these medicines make people to suffer from side effects and sometimes these may lead to leave their valuable lives.

1.1 Role of Technology

As a solution to the above requirements and problems many rules were framed to present at least minimum details of medicine.

Though currently using labels contain minimum information about the medicine, some of the drawbacks exist. Some of them were:

- Small Typeface
- Narrow Spacing
- Poor Design
- Easy to Duplicate
- Easily tampered
- Less details
- Less GUI connectivity

1.2 Solution for Identity

Bar coding has introduced to identify fake medicines. It is powerful at that time. Some of the advantage in this method is least cost and powerful at that time. Only the cost of ink on the paper. So, it is easily adopted in every system at that time.

Still there is disadvantage in this solution. They were:

- Easy to duplicate
- Require line of sight
- No use if a label is tare.

2. PROPOSED SYSTEM

We propose a solution to this problem is to introduce a Bluetooth enabled chip in the cap of the bottle.

Here it involves both hardware and software.

2.1 System Architecture

Here System architecture includes medicine bottle embedded with Bluetooth module that which have UUID's to identify particular bottle. This bottle is scanned with smart phone using bluetooth and connected to it. After connecting to the bottle we can see medicine's name, expiry and manufactured date, manufacturer name and mainly national drug code which will be unique for different drugs.

After getting National Drug Code (NDC) of the medicine from the bottle by using NDC code we can retrieve more details like warnings, dosage, precautions etc., the app will be connected to the server and from there the data is retrieved and is presented to the user automatically without any manual entry of IP address etc..

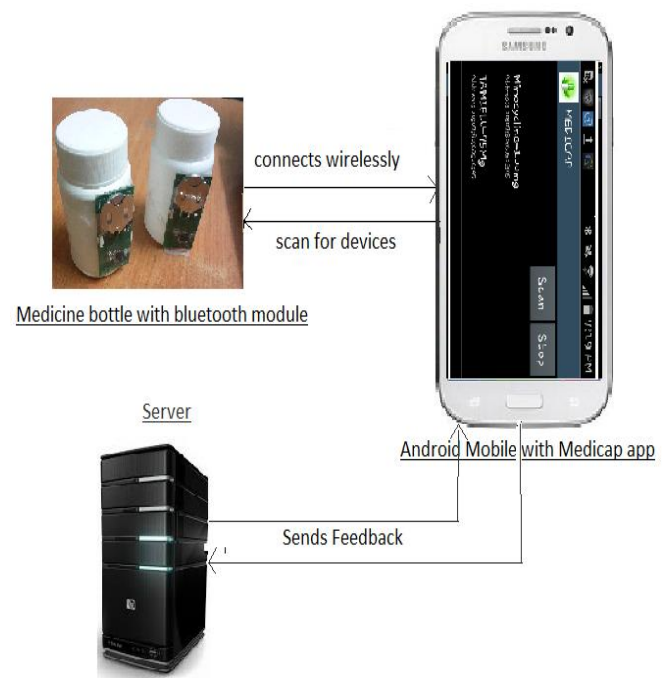


Fig -1: System Architecture

2.2 Hardware Implementation

Here Bluetooth module is of version bluetooth 4.0. Because of the changes in stack implementation of bluetooth it consumes low energy. So, it will be appropriate to made bottle available for longer period of time.

Why Bluetooth?

For identity purpose we can also use RFID tags. The cost will also be less. But problem here involves is to read rfid tags we need rfid reader. It can be used in pharmacies to maintain stock but it can't be used by common man as it involves RFID reader which costs high.

As a solution to this bluetooth comes in handy. As the technology increases because of Wi-Fi, Zig-bee technologies bluetooth can be used with no cost. It will be a best solution to communicate in smaller distances. And another thing is to read data from the bluetooth enabled device there is no need of any readers. Now all of the smart phones have the ability to connect to the bluetooth device and can retrieve accessible data from that device. So, for the customer there is no need to purchase particular reader to retrieve data from the medicine bottle.

So, here we introduced bluetooth enabled chip on to the cap of the bottle.

While manufacturing the bottles the proposed chip is introduced into the bottle. When coming to chip, in bluetooth 4.0 we have the device with the capability to provide services. Under a service there will be some characteristics and also descriptors will be there under characteristics. There we can made particular characteristic as read or write or both. Here as a service we included expiry date, manufactured date, manufacturer details,

medicine names and mainly national drug code. As these were made to read only it can't be changed by others in between from manufacturer to consumer. So, there will be no chance of entry of expired and fake medicines into the market. As it deals with national drug code it is not easy to duplicate medicine.

Here we implemented it as a prototype, actual size of the hardware will be 4.6 mm x 5.6 mm x 1.0 mm.



Fig -2: Prototype medicine bottle with bluetooth chip.

2.3 Software Implementation:

While coming software here we developed an android app to get details of the medicine. As we are using mobile GUI interface we can present more details to the consumer. There is no restrictions of space. And there wouldn't be problem of smaller typeface. Consumer feels more comfort to access correct data without taking help from others. No need to know more technical details. It is easy to use. Consumer has to just open the app and has to scan for medical devices and has to choose the medicine he wants.

Sample Code:

To scan for Medical Devices:

```
appContext = Android.App.Application.Context;

// get a reference to the bluetooth system service

this._manager=(BluetoothManager)appContext.GetSystemService("bluetooth");

//get adapter from manager to access all bluetooth stuff

this._adapter = this._manager.Adapter;

//gattcallback instance to access gatt services and characteristics

this._gattCallback = new GattCallback(this);

//here medicineuid is 128 bit unique universal identifier

_adapter.StartLeScan(medicineuid,this);
```

```
// in 10 seconds, stop the scan
await Task.Delay(10000);

// if we're still scanning
if (this._isScanning)
{
    Console.WriteLine("BluetoothLEManager:Scan
timeout has elapsed.");
    this._adapter.StopLeScan(this);
    this.ScanTimeoutElapsed(this, new EventArgs());
}
```

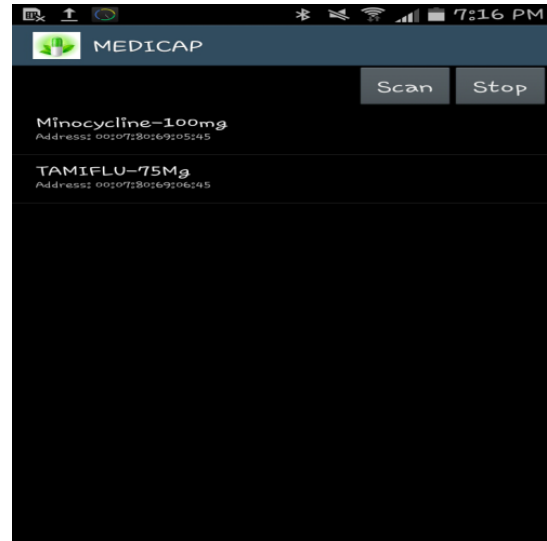


Fig -3: Screenshot of Scan for medical devices

By connecting to it he can get details of medicine name, manufactured and expiry date, national drug code along with manufacturer details. To connect to that medicine just user has to select medicine from the scanned list.

Sample code to connect to device:

```
public void ConnectToDevice(BluetoothDevice device)
{
    // returns the BluetoothGatt, which is the API for
    BLE stuff

    Thread.Sleep(1000);

    device.ConnectGatt(Android.App.Application.Context, true,
    this._gattCallback);
}
```

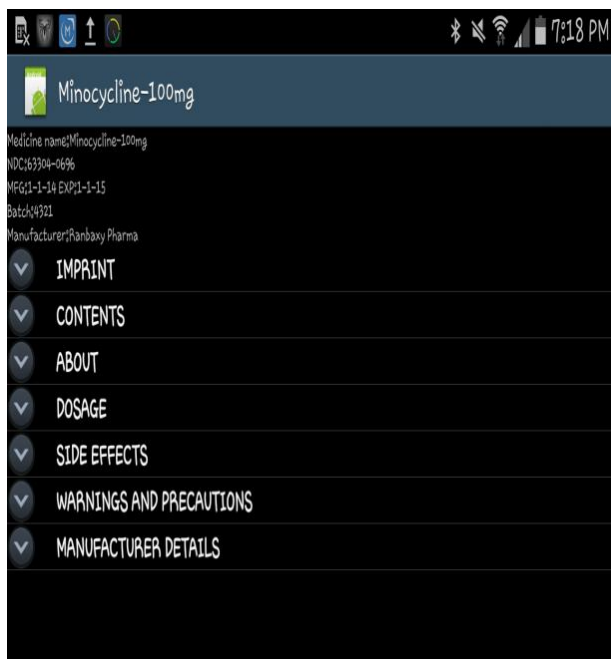


Fig -4: Screenshot of connected to a medicine

If he/she wants some more details he/she can access the details from clicking on the list item. By that consumer can easily access warnings and precautions, what are the side effects related to that medicine and whether the medicine is from certified company or not and also can access details like imprint on the drug and contents in it etc.. can be accessed.

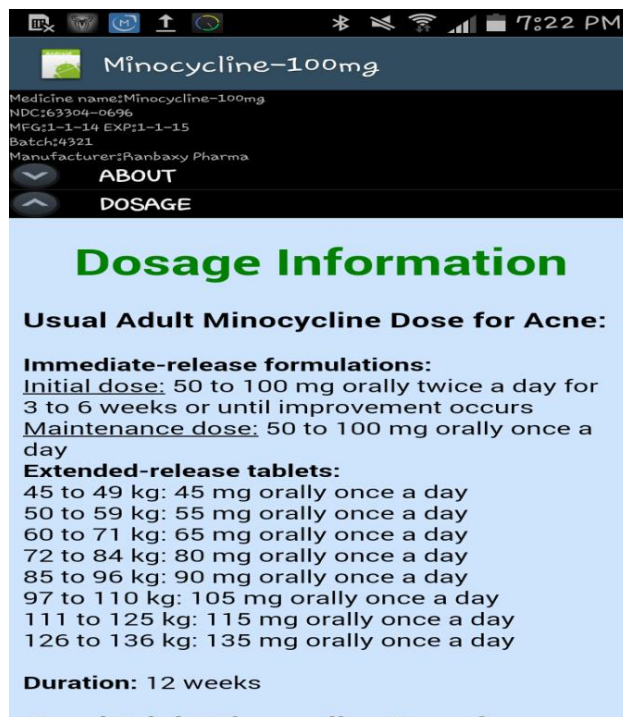


Fig -6: Screenshot of medicine dosage details



Fig -7: Screenshot of manufacturer certification details

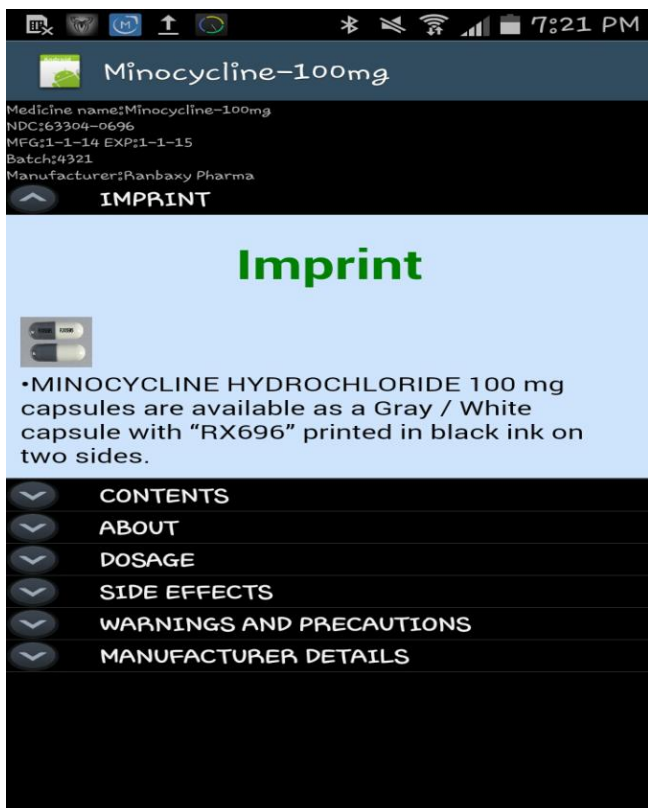


Fig -5: Screenshot of accessing medicine details

If consumer wants to send feedback to the manufacturer he/she can send the feedback to the manufacturer’s server. If any side effect arises because of the consumption of the medicine it can be sent to the manufacturer through feedback activity.

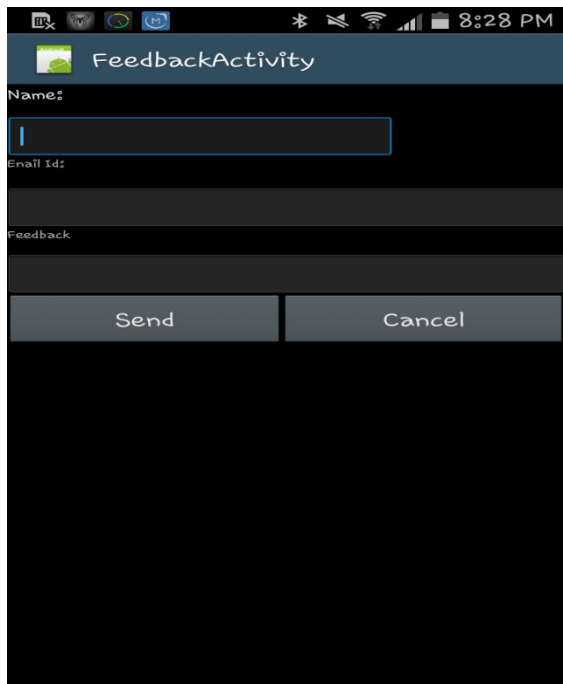


Fig -8: Screenshot of feedback form

It will also be used for old age people to set reminder to alert them to take particular medicine of particular dosage for particular interval of time. So, they wouldn't need to think of medicine dosage. Just while they get alert they can consume that medicine without seeking help from others. If any employee has to look after children or old age people to give particular medicine at particular intervals then there is no need to take leave to remind them. Just they can set reminder in the name of patient and whatever the dosage suggested by the doctor and at what intervals to consume. Whenever the time to take medicine arises it send alerts to the consumer.

3. CONCLUSION

I conclude this by saying that it is a new idea to prevent entry of fake medicines into the market and a new way to present more details about medicine to the consumer, as well as a way to send feedback to the server's. It can also be used to remind the consumer to take particular dosage of medicine at particular interval of time.

For future enhancement we can add some other modules to get stock in the bottle etc.,

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