FM RADIO BROADCASTING USING RASPBERRY PI GPIO

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ABSTRACT

Radio broadcasting is a revolutionary technology which changed the way of world communicated. It enabled large scale broadcasting, in a world where information spread slowly only through means of newspaper. In today's world, this low cost medium is specifically suited to reach communities and vulnerable people. Our project uses a raspberry pi to explore this old technology. We use memory mapping and the hardware provided to generate spread spectrum in raspberry pi to output FM radio energy. Use of low level language is being used for memory mapping and it is encapsulated with higher level language, increasing the portability of the project. The additional layer of abstraction makes it more convenient for the general user to broadcast on the FM band and makes it a smart radio. Use of web server allows the broadcast to be controlled through HTTP and a simple android app makes it easier to navigate. This paper first discusses the technical aspects of the projects. It then explores the possibilities and legalities of broadcasting on FM band. Another small problem that we are simultaneously looking at is to synchronize music on end devices.

Keywords— *"Speed detector", "Traffic", "Camera***"**

1. INTRODUCTION

With rising speeds of internet and thus internet streaming services, radio technology, which was once the sole way of broadcasting and communicating long range instantaneously, has seen a decline in the use. The Internet which once did not have a large enough bandwidth to send messages at once, or took long time to send images has seen a great boost in its bandwidth. Only about 3% of the population had access to internet in 1998 whereas in 2016, it increased to 48%. Unlike radio, internet has a vastly greater range. Data can be shared globally, is much less noisy and can be encrypted accordingly. Internet is suited for broadcasting, end to end communication as well as

multicasting. This makes it a better channel for sharing of information than radio which is only used for broadcasting and end to end casting.

There are very few ways in which radio is a better medium of communication and this paper discusses a few of those advantages.

Radio requires very little infrastructure to be used. A radio transmitter and radio receivers by the listeners can be used for broadcasting. Both the transmitter and receiver consume very little electricity. Both the components can be made using simple electronic parts and complicated protocols are not required to engage in smooth flow of information. Wiring between the receiver and transmitter is not required. As it consumes very little electricity, it can be reliably used during power cuts with the use of batteries. Receivers require lesser energy than transmitter so it can be used by anyone with a receiver and a couple of AAA batteries.

During emergencies, there is a possibility of power cut which will result in people not being able to use their internet. At those times, FM/AM radio can be heavily used to direct the population and give them information which they otherwise cannot receive.

Historically, many governments have interfered in the Internet by either censorship or complete blockage. A rogue government can impede communication between its citizens by blocking internet. and make certain decisions on whether to send a ticket or not to the registered citizen.

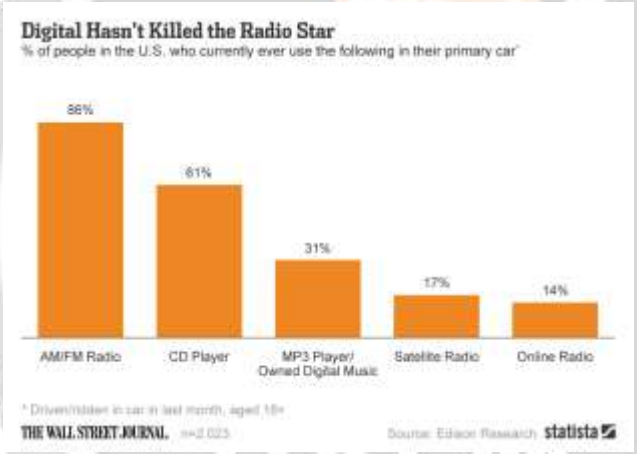

Fig 1 : Statistics on usage of radio in USA.

1.1 Existing Systems

Various solutions have been developed to solve the problem of synchronisation of music in devices. It was tackled very early by smart phone manufacturers. Samsung had developed a music synchronisation app which allowed users having phones with that software to synchronise music over WiFi. The feature was called as group play and it was only available on Samsung devices.

Today there are various apps available on Android playstore which claim to do that. A popular app among them is AmpMe which uses the same host and listener protocol where in one of the devices acts as the host and the others as listeners. The app sends the cues through the Internet and not WiFi.

Another way in which this problem is being tackled is by selling music systems which are capable of synchronizing music amongst themselves. Some popular options are Sonorous, Google Home Max and Amazon speakers such as Alexa, Dot and more. They use their own proprietary technology to solve this problem.

A very popular alternative to use of radio is streaming which seems to be rising as Internet speeds are getting better and the range is getting wider.

Figue 2 : Amazon echo smart speakers.

1.2 Issues in Existing System

All though there seem to be various solutions to this problem there are many requirements in them which don't make them a good choice. For the group play feature by Samsung, it is necessary to have a Samsung smart phone which has this particular feature available. Similarly in case of speakers by sonorous, Google and Amazon you need to own their particular brand of speaker to be able to synchronize music. The companies have chosen to not share their technology with each other which results in the requirement of owning the same type of speakers. Apart from that, the speaker themselves are quite expensive.

As AmpMe have chosen the Internet as their communication medium, a very stable and fast Internet connection is required among devices to actually able to synchronize music. Currently very few places have good stable Internet to make this possible especially if the Internet provided by the cell phone signal carrier is used. All of these solution have one common problem i.e. they are either not portable or cannot be connected to many devices. The proposed solution is exactly going to tackle that.

1.3 Proposed System

This section intends to briefly introduce the readers to the proposed system. There are modules involved in this system which each target a certain problem. The hardware part will consist of a raspberry Pi board and a jumper wire to act as an antenna. A micro usb cable and power supply will also be required to power the raspberry pi. The software will consist of the module which will allow memory mapping, and a flask environment to run a web server to control the raspberry pi easily through the use of smart phones or computers. Additionally, jQuery will be used for better UI support, AJAX for asynchronous commands. For securing the server basic web authentication will be used.

2. SYSTEM ARCHITECTURE AND COMPONENTS

This part covers the architecture of the system. It comprises of a hardware part and a software part. For the purpose of simplification, the architecture diagram is divided into two parts namely the software and the hardware part. Both the parts require frequent interaction with each other and amongst themselves. Apart from that, each of these parts are supposed to be modular i.e they should not depend on each other.

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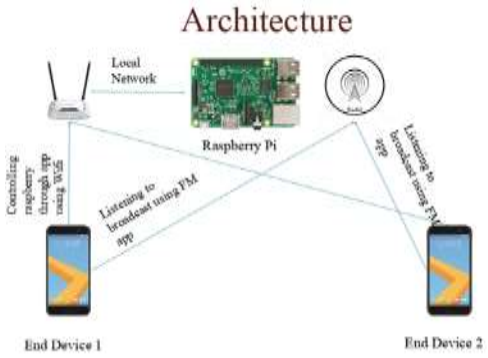

Fig 3 : System Architecture Diagram

The above Figure shows the system architecture of the proposed system. It depicts conceptual model of communication between user and the system.

Hardware Modules :

2.1. Microprocessor:

Fig 4: Raspberry Pi : A Single board computer used for purpose of experimentation for this project

For the purpose of experimentation we have used a full fledge single board computer called raspberry pi. This board uses a ARM based microprocessor and it has a controller which can perform complicated tasks. For real systems, other stripped microprocessors can be used which will reduce the cost of the device. The python library calls a C program (provided both precompiled and in source form). The C program maps the Peripheral Bus (0x20000000) in physical memory into virtual address space using /dev/mem and mmap. To do this it needs root access, hence the sudo. Next it sets the clock generator module to enabled and sets it to output on GPIO4 (no other accessible pins can be used). It also sets the frequency to 100.0Mhz (provided from PLLD@500Mhz, divided by 5), which provides a carrier. At this point, radios will stop making a "fuzz" noise, and become silent.

2.2 Antenna:

In radio an antenna is the interface between radio waves travelling through electric and space currents moving in metal conductors, used with a transmitter or receiver. In transmission, a transmitter supplies an electric current to the antenna's terminals, and the antenna emits the energy from the current as electromagnetic waves or as known as radio waves. In reception, an antenna intercepts some of the power of an electromagnetic wave in order to produce an electric current at its terminals that is applied to a receiver to be amplified. Antennas are essential components of radio equipment, and are used in radio broadcasting, broadcast television, two-way radio, communications receivers, radar, cell phones, satellite communications and other devices. An antenna is an array of conductors (elements),

electrically connected to the receiver or transmitter. During transmission, the oscillating current applied to the antenna by a transmitter creates an oscillating electric field and magnetic field around the antenna elements. These time- varying fields radiate energy away from the antenna into space as a moving transverse electromagnetic field wave. Conversely, during reception, the oscillating electric and magnetic fields of an incoming radio wave exert force on the electrons in the antenna elements, causing them to move back and forth, creating oscillating currents in the antenna.

Above is a circuit of the low pass filter. The low pass filter is required to reduce the noise and to prevent the signal from leaking into other signals. It is unethical to run it without the circuit as leakage into other signals ruins the experience for others.

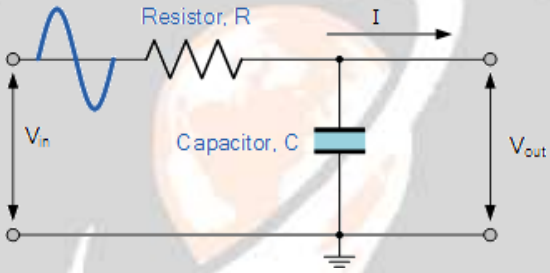

Figure 5: Low pass Filter Circuit

2.3 Storage:

There are various options of storage of songs/audio to play for raspberry Pi. The simplest of them is to use the internal memory of raspberry pi which is basically the SD card of the raspberry pi. The audio files can be stored in the root directory in a folder. But this makes adding more songs very difficult. For that we can use the alternative of usb drives. A plug n play functionality can be created for USB devices. This is also reduces the wear on the on raspberry Pi SD card giving it a better shelf life.

3. CONCLUSIONS

In today's world, we are seeing a growth in authoritarian governments. These governments usually have the power to block various channels of communication such as the internet and cell signals due to various unfortunate laws.

If a government turns rouge against its own citizens, and starts enforcing these blockage at their own will, it will be very dangerous to the democracy of the nation.

Radio communication, although has many reasons for dying now, will take a lot of time to completely go away. Services such as internet streaming provide many more features in comparison to radio. But these services require the Internet and devices that can connect to the Internet. On the contrary the radio is very cheap and readily available.

4. REFERENCES

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