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Designing of passive RFID based sensor solution for indoor localization

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Abstract: ***This paper attempts to define how far the tagged objects be located in an indoor environment. Passive RFID tag distributions provide enough accuracy and precision in localization with low cost. The novel system utilizes the effectiveness of identification devices such as sensing and measuring the distance of an object. The system is controlled by a microcontroller to extend its performance. The output of microcontroller is communicated to the user through APR voice module. This module is a user friendly playback recorder and the recording time be varied from 32 to 60 seconds.***
Keywords***: Passive RFID, sensor, voice module, controller, speaker.***

I. INTRODUCTION

The popularity of identification devices are rapidly growing and so highly implemented in many applications such as automatic identification and tracking.UHF RFID location systems are mostly preferred as it is applied for single item tracking in 3D environment due to long sensing range and high transmission rate. Others are not considered due to low data rate and high sensitivity to environment. RFID localization is cost effective and suitable to identify and locate objects in indoor environments.The fundamental of this technology is that a spectrum of radio frequency is used to transfer the identification information between two communication devices such as RFID tags and RFID readers. This technology offers longer working distance and faster reading ability.

A small electronic gadgets in RFID contains a small chip which is capable of accumulating approximately 2000 bytes of data or information and an antenna. RFID devices had replaced a magnetic strip simply say as bar code that are noticed at the back of a credit card or ATM card for an unique identification code. The RFID is comprised of two hardware components. The transponder is positioned on the object to be scanned and the reader implies read device or a read & write device, depends on the system design, technology used and the requirement of specific application. The RFID reader typically comprise of a controlling unit for configurations, a monitor, a radio frequency module, and an antenna to investigate the RFID tags. Also having a number of RFID readers that are built-in with an extra interface allowing them to transmit the data received to PC. RFID tags contains a RFID transceiver that helps to transfer the data from one system to another. There are 2 kinds of RFID tags- Active tags & Passive tags. RFID technology is used in a number of industries to carry out various tasks such as asset tracking, Inventory management, Controlling access to confined areas, Personnel tracking, Supply chain management, Counterfeit forestalling (e.g., in the pharmaceutical industry).

The changes in an events or an environment are detected by sensors and takes the input as light, heat, motion, pressure and provides the output in various forms. Motion sensors are popular in localization as it detects the flow of energy that is interrupted by something and also used in various systems home security lights and automatic door.

II. IDENTIFICATION DEVICES

A. Passive RFID

Passive RFID systems are mostly preferred because its tags gets powered by the electromagnetic energy transmitted from an RFID reader. Instead, Active RFID systems utilize battery dependent tags which continuously transmit their own signal and use “beacons” for exact track the real-time location of assets or in high-speed environments such as tolling. A Passive tags gets activated only after receiving a signal from an RFID reader. The reader sending their energy to an antenna which converts that energy into an RF wave and sent into the read zone. Once the tag get read within the read zone, the RFID tag’s internal antenna draws their radio frequency wave energy which get transmitted from the tag’s antenna to the IC for powering the chip and generates a signal back to the RF system. This is typically known as backscatter and this backscatter(change in the electromagnetic or RF wave) is detected by the

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reader of antenna and interprets the information.

Passive RFID tags operates in three levels of frequency along with some other factors has strongly determines the attachment materials, read range and application options.

1) *LF(125 – 134 KHz)*: A very long wavelength characteristically used for an animal tracking as this range is slowly affected by metal or water and have a short read range of between 1 – 10 centimetres.
2) *HF(13.56 MHz)*: A medium wavelength used with access control applications, data transmissions, DVD kiosks, and passport security applications because they do not require much long read range. They have read range between1 centimetre to 1 meter.
3) *UHF(865 – 960 MHz):* A short, high-energy wavelength of almost 1 meter which translates to long read range. Passive UHF tags can read from an regular distance of about 5 – 6 meters, but superior UHF tags can achieve up to 30+ meters of read range in ideal conditions. This frequency is typically used with file tracking, race timing, IT asset tracking and laundry management as all these applications usually require more than a meter of read range.

B. Ultrasonic Sensors

This device works on a principle of transducers used in radar and sonar systems, which evaluate the attributes of a target by interpreting the echoes. Based on the properties of acoustic waves, ultrasonic sensors allows frequencies above human audible range. Ultrasonic sensors are non-intrusive which means do not require any physical contact with their target, and can detect certain clear or shiny targets otherwise obscured to some vision-based sensors and also their measurements are very sensitive to temperature and to the angle of the target. For most ultrasonic sensor applications, it is desirable to have a relatively narrow beam pattern to avoid unwanted reflections.

In active ultrasonic sensor, the distance of an object is determined by the time interval between sent high frequency signal and received back an echo. Passive ultrasonic sensors basically microphones which detect ultrasonic noise at certain conditions and convert it to electrical signal and report it to computer.

Ultrasonic sensors basically utilize three physical principles such as time of flight for sensing distance, the Doppler effect for sensing velocity and the attenuation of sound waves for directionality.

The ability of humans to detect objects in an environment by sensing echoes from those objects are called echolocation which is employed by bats and dolphins to find prey. Blind people also have this ability for acoustic wave finding or navigating within their environment. Echolocation is also called as bio sonar.

III. PROPOSED WORK

This paper aims to employ the object localization through identification devices and echolocation principle especially in indoor environment. The whole system is designed for visually challenged people as they are capable of detecting the acoustic echoes and so they are safely navigating within their environment. The design of this system is mainly composed of Ultrasonic sensors and passive RFID devices.8051 microcontroller is used to control those devices and the APR voice module is used for the communication in indoor environment. The sensor detects how far the system module gets closer to the object and send that details to microcontroller in digital format. Then, the controller instructs that information to the person in indoor environment through recorded voice. This project utilize APR9600 voice module which is an user-friendly Voice recorder & playback module and works without any battery backup and has Nonvolatile Flash memory Technology in hardware side. At simulation side, the distance details has been displayed in LCD as the APR module is difficult to simulate in software. And the block diagram of the proposed system has shown in Fig.1.

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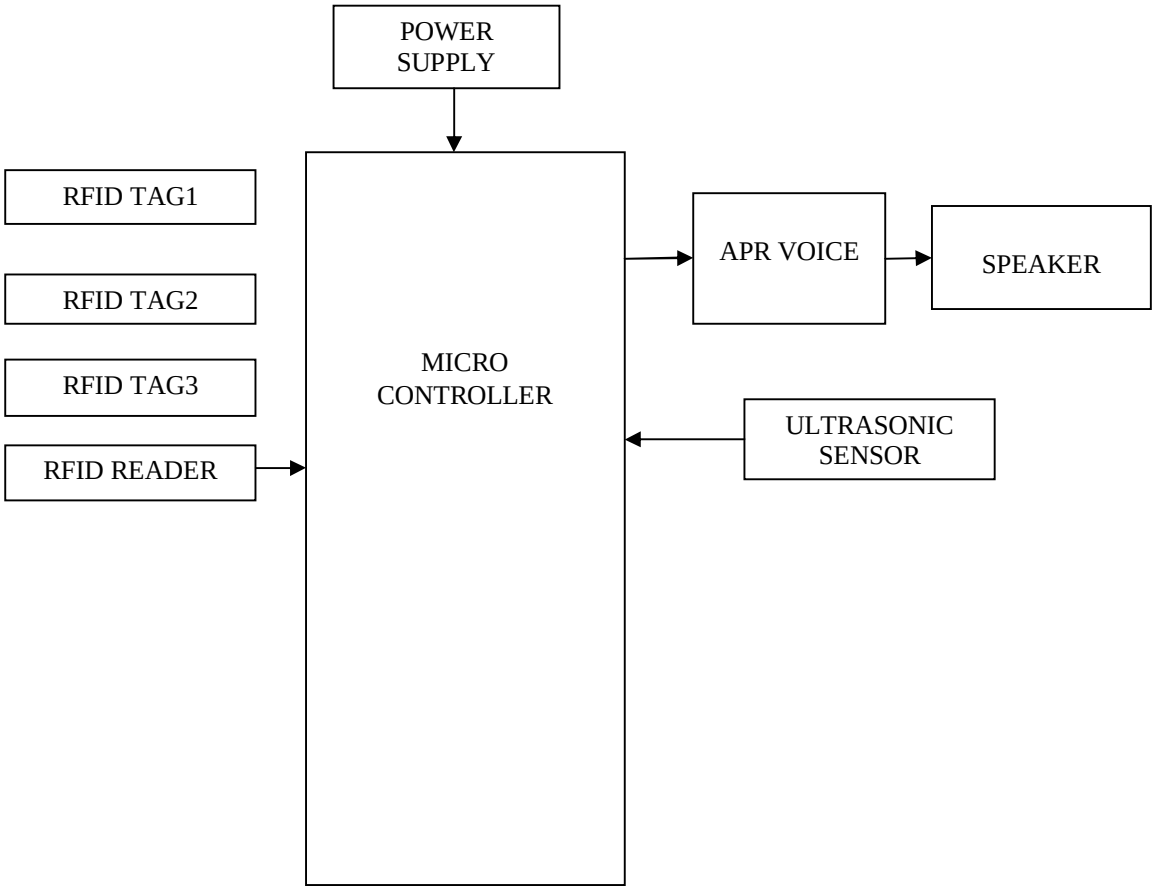

Fig.1.Block diagram for localization

Ultrasonic sensors follows the echolocation principle and the distance of user's object is detected by the time interval of sending and receiving signal. This sensor has three modes of operation and the modes will be chosen with respect to the application. Our system needs time of flight mode as detection of distance is enough. Ultrasound is most commonly generated as a direct conversion from electrical energy. This is accomplished by applying a rapidly oscillating electrical signal to a piezoelectric crystal attached to a mounting. The charge causes the crystal to expand and contract with the voltage which generating an acoustic wave. The waves are later detected by a piezoelectric receiver, which converts the waves back into voltage using the same method. Speakers typically have filter circuits to prevent ultrasonic propagation, and the frequency response of many microphones roll off in this range. This is partly because of the amount of ultrasound present in our daily life; percussive sounds and metallic ringing both contain ultrasonic frequencies. Passive RFID systems tags gets powered by the electromagnetic energy transmitted from an RFID reader. This module is preferred in real time tracking due to their smaller, cheaper, flexible and long last life time without any internal battery.

IV. SIMULATION

Proteus simulator is available from Lab centre Electronics for powerful electronic design application. It has various design features such as Schematic capture, Mixed-mode (analogue and digital circuit) electronic circuit simulation, Microprocessor / microcontroller Simulation, PCB design with manual and autrouter options Graph-based simulation.

Keil µ vision3 software is used for programming the 8051 microcontroller and it sets all compilers, assembler, linker, and memory options. The simulation output has shown in Fig.2

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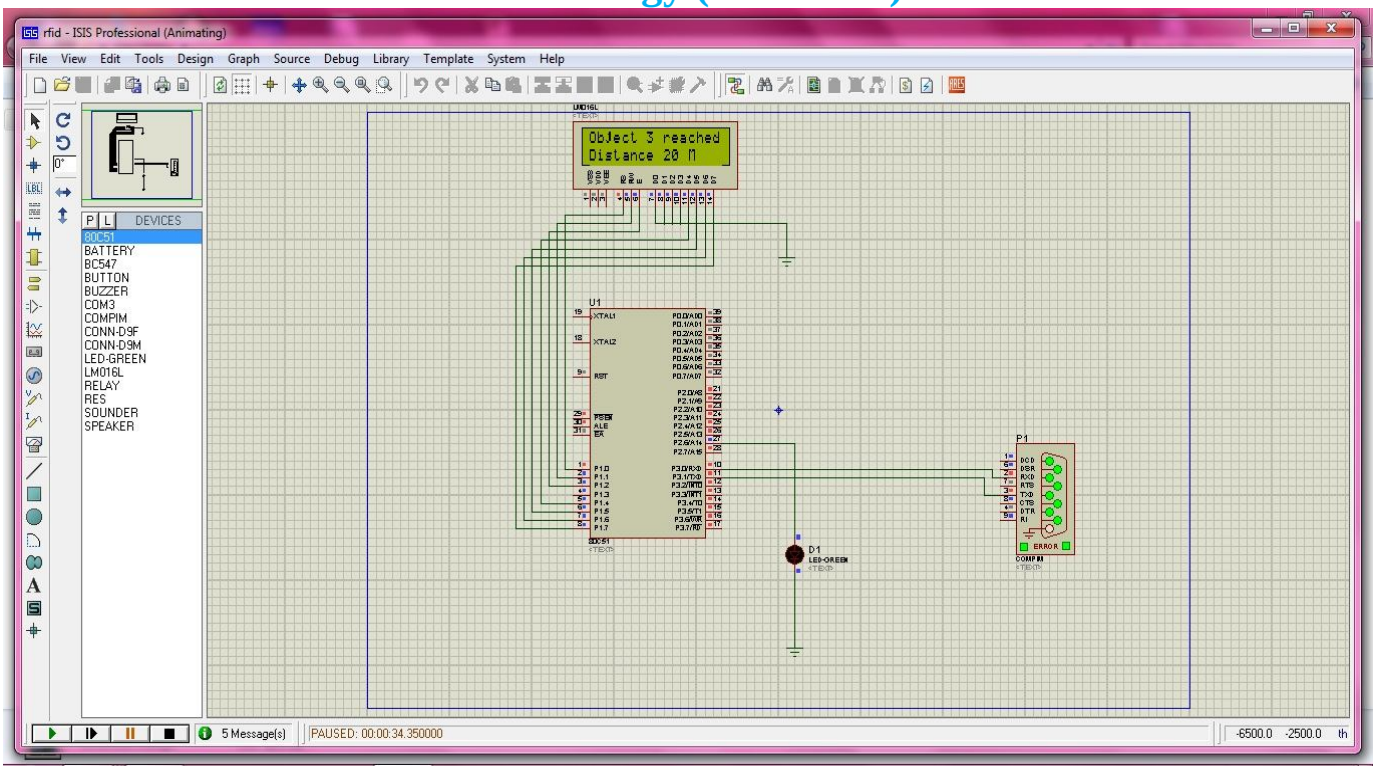

Fig.2.Simulation Output

V. CONCLUSION

This paper describes how the passive RFID modules has sense and how the motion sensors can detect the distance of tagged object within their environment .The user may track their object location at better accuracy and precision level. The proposed system follows backscatter and echolocation principle and its output has been achieved through simulation.

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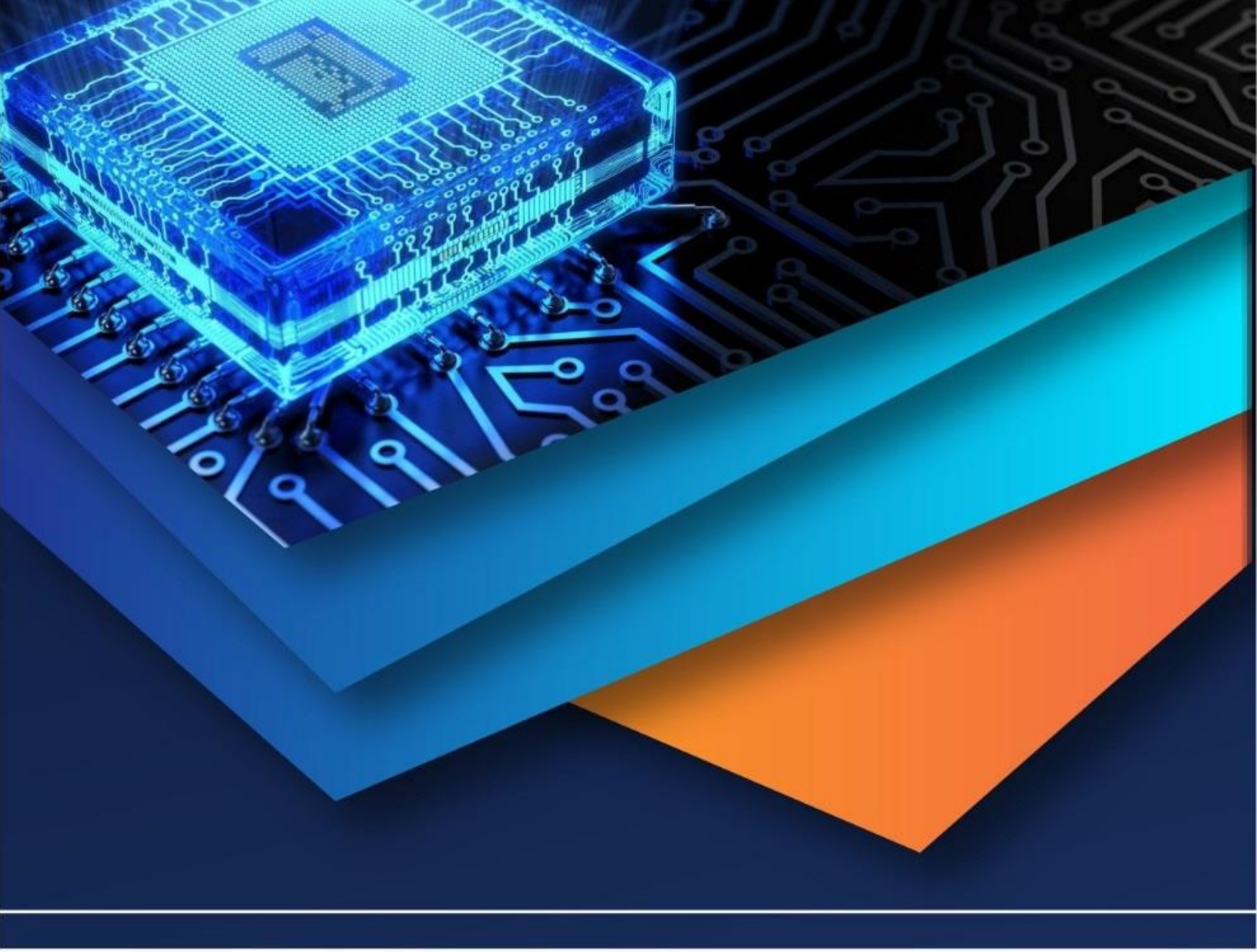

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