

SAFETY DEVICE BASED ON IOT TECHNOLOGIES FOR CHILDREN

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Abstract: Safety Security to children is a complex challenging task for the society to focus on this a system has been proposed. Current state of art have many system that provide log details about each child right from the moment they enter the bus and reach the school until they leave the school, which provides security only on their way to school. The Security issue of children is not only limited to their way to school. This proposed system presents Safety System Device based on IoT (Internet Of Things) technologies for children, which provide security not only on their school but also in school premises. The proposed system provides log details about every child from the moment they board the bus and reach their destination with this it also helps parents to monitor their child. For tracking individual student while boarding and leaving the school bus RFID (Radio Frequency Identification) reader is used. To enable the communication between child safety device and parent android phone, SMS (Short Message Service) text communication is used here. The GSM (Global System For Mobile Communications) technology is used for reliable communication. Proposed child safety system shows alternate two options to send alert message to parent device. One is by pressing button and another is through voice command. Voice recognition module is used to give voice command, which identifies child voice and sends alert SMS to parents automatically. Parents with android application in their smart phone through which they can get child's location, photo, police station near to child and also can send complaint message to police station. The child device is activated or deactivated notification will be sent to parent's device automatically. Proposed system provides complete secure environment for schoolchildren.

Index Terms - RFID Reader, GSM, Android, IoT, Child Security and Voice Recognition.

I. INTRODUCTION

The Internet of Things (IoT) is a system of interrelated digital machines, computing devices and mechanical objects, people or animals that are provided with unique identifiers and the capability to delivery data over a network without requiring human-to-human or human-to-computer communication. IoT is low cost technology. For parents the safety of their children is fundamental and a low cost technology may give a huge contribution to it. Today education system is facing the new challenge apart from its academic responsibilities. These new challenge is foremost priority which the parents are expecting from the education system. This new and complex challenge is safety and security of the children. This is complex because of increasing crime with children while travelling home to school and vice versa and also in the school premises.

Good education along with full proof security is the top most priorities of the school and parents. The above situation increases the scope of new technology for security of children.

Hence IoT is playing a vital role in over coming issues related to security challenges. As Security issues start from school transport, IoT based security system provide good result [5] There are many device available which use unreliable source of communication it may be a Bluetooth or Wi-Fi. GSM mobile communication which is available everywhere, it is reliable compared to Bluetooth and Wi-Fi communication as discussed by [11]. The parents can get their child's information by using android application called Guardian which provide children current location, photo, police station near to child, and also can send complaint message to police station. GPS system is used to locate child accurately this way parents can monitor their children till they reach home. Child can also communicate with parents through Child Safety Device.

II. RELATED WORK

In the article [1] author presented School Security System (SSS) through RFID. This article is combination of RFID, GPS/GSM, image processing, WSN etc. The focus of the work was student arriving to Bus/Campus safely. Lacking to provide efficiency in tracking, to overcome this problem passive RFID tracking technology used in the article [2], is capable to tracking and monitoring child efficiently. The passive RFID system started being used widely for localization system, but it has small sensing range in the area of pedestrian localization deployed tags may not cover unreliable moment of pedestrians. In the article [3] author addressed the above problem by using hybrid RFID localization system. To improve the quality of school transport system the article [5] presents scholar bus monitoring system based on IoT. In the articles [1,2,3,5] discussed existence of child in school Bus/Campus. If child in problem there is no option provided child to communicate their parents. This kind problem addressed in article [4] author proposed a system, which gives information if child is crying. For that used voice play back circuit .in the article [7,8,10] smart wearable device are proposed for women, which are not suitable for child. Some wearable device contain heartbeat sensor it is not use full in case of child because they do many activity during school there heart bets vary each time. In the propose

Child Safety Module voice recognition sensor is used which gives more accurate result. The proposed system is to provide security starting from way of school to home vice versa and also taken care of inside school premises.

III. SYSTEM DESIGN AND METHODOLOGY

3.1 Based on the Related Work Objectives of the Work are:

- The main objective is to reduce the issues related to security for children not only their way to school but also monitoring the child if they are missing from school.
- Use SMS as the mode of communication, which are fewer chances of failing compared to Wi-Fi and Bluetooth.
- Providing user-friendly options to child and parents to communicate each other.
- Avoiding sensors used are not helpful incase of children monitoring. Like heartbeat sensor.

This is the complete design of Child Safety Device system is shown in figure 1. The block diagram is mainly divided into three modules as school bus set up, child device set up and parent device set up.

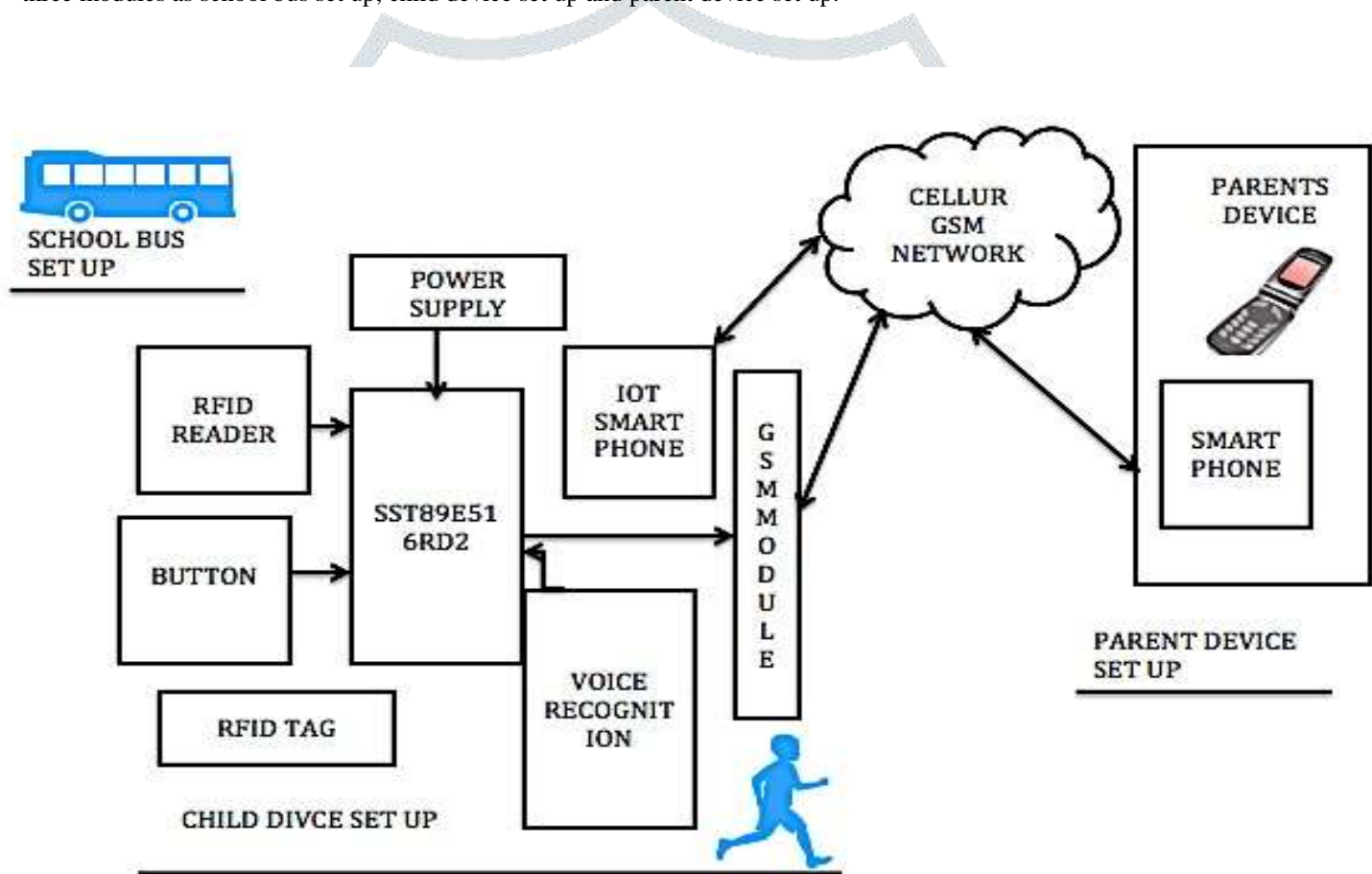


FIGURE.1 BLOCK DIAGRAM OF CHILD SAFETY DEVICE.

The GSM technology is used to send SMS to parent cell phone. The child device contains a SST89E516RD2 microcontroller, GSM module, and Voice recognition module V3, RFID tag, button and IoT smart phone for GPS and camera. Both the child device and parent's device communicate with each other through android application called Guardian App. In help needed situation child gives voice command the microcontroller triggered by voice module and sends SMS and an alternative option is achieved by pressing specific button microcontroller pin gets high and sends SMS. When child enter and exit school bus RFID reader reads tag number and send SMS to parents. Using guardian application parents can get location, photo, police station near to child and also sends complaint SMS text to police station. Also parents will be updated with child image.

IV. HARDWARE USED

4.1 SST89E516RD2

The SST89E516RD2 is 8-bit microcontroller. SST stands for silicon storage technology. It consists of 40 pins in that 32 pins are used as I/O pins. It consists of 64 KB ROM, 1KB RAM which is sufficient memory.

GSM (Global System For Mobile Communications)

GSM is digital cellular technology. Which provide services of transmitting mobile voice and data. For mobile communication system it is used widely in the world. GSM operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. In proposed system GSM technology used for reliable communication between child safety device and parent mobile phone.

4.2 RFID Reader (Radio Frequency Identification Reader)

A radio frequency identification reader (RFID reader) is collecting information from an RFID tag, which contains unique number, which is used to track individual child. Radio waves are used to transfer unique id from the tag to a reader.

The RFID reader having limited range, so RFID tag must be within the range. It ranges from 3 to 300 feet, in order to be read. In proposed system using RFID reader technology collect log details of school bus entrance and exit.

4.3 Voice Recognition Module

This Voice Recognition Module is a board, which is small in size and easy-control speaking recognition. Voice recognition module is a speaker-dependent. Voice recognition module supports up to 80 voice commands. But only 7 voice commands can work at the same time. Command could be trained as any sound. Before let it recognizing any voice command users need to train the module first.

4.4 GPS Global positioning system)

GPS (Global positioning system) is built on the transmission of a signal to the satellite, which identifies child position globally. In mobile phones the GPS system works on the strength of the signal connection of the SIM network which we use.

V. DESIGN

The algorithm for Child Safety Device set up and parent's device set up bus set up.

5.1 Child module set up

Child activates child safety device when it receives command. Depending upon the commands given it will provide results. Commands are given through sensors as voice recognition module and button, which are pre programmed in system. Child safety device system is explained below with algorithm.

5.1.1 Algorithm for Child Safety Device

Input: Button, Voice Commands

Output: Alert Messages to parent device

Step 1: Assign pins configuration of all the modules as GSM module, Voice module and Button.

Step 2: Set baud rate 9600 for receiver and transmitter communication.

Step 3: Repeat step 4 until pin=0 (not Button pressed or no Voice command Received).

Step 4: Initially all pin value set equals to low.

Step 5: if Pin=1 (if button Pressed) sends SMS go to step 9.

Step 6: Else if pin=1 (by Voice Command) sends SMS go to step 9.

Step 7: In case of voice command child give voice input command to voice module.

Step 8: if voice match send go to step 6.

Step 9: Stop.

5.2 Parent device setup

A parent smart phone has android application called guardian that communicates with child safety device smart phone which also has android application called IoT. Parent mobile device system is explained below with algorithm.

5.2.1 Algorithm for Parent Smart Phone

Input: Giving command through guardian application.

Output: Receiving alert text SMS messages and voice SMS.

Step 1: Active GPS location and Internet in the parent mobile and child mobile.

Step 2: Open the guardian application.

Step 3: Enter child mobile number.

Step 4: Select the button according to information needed.

Step 5: To get location of the child. Go to step 1, 2, 3, 4 and 6.

Step 6: Select loc button.

Step 7: Parent device get location id number and directly open Google map in parent mobile and show the child location. Go to step 20.

Step 8: To get photo of the child surrounding. Go to steps 1,2, 3,4 and 9.

Step 9: Select photo button.

Step 10: Child device receives input and takes the surrounding photo, And reply to mail id, which is set in the child device. Parent can check his mail id to get photo. Go to step 20.

Step 11: To get information about child near by police station. Go to steps 1,2, 3,4 & 12.

Step 12: Select near info button.

Step 13: Copy location ids pastes it in first edit box and delete first 4 digits without space.

Step 14: Type key word police without space in second edit box and press get button.

Step 15: Child device receive input and send list of police station near by child to parent device and go to step 20.

Step 16: To send complaint to police station. Go to steps 1,2,4 and 17.

Step 17: Enter police station number and Select compliant button.

Step 19: Child device receive input and send SMS message to police station.

Step 20: Stop.

5.3 Bus set up

School bus is fixed with a RFID Reader which reads a individual student tag number once he enter bus with RFID Tag. School bus RFID Reader is explained below with algorithm.

5.3.1 Algorithm for Bus

Input: RFID Tag

Output: Alert Messages to parent device

Step 1: Assign pins configuration of all the modules as GSM module, RFID Reader .

Step 2: Set baud rate 9600 for receiver and transmitter communication.

Step 3: Repeat step 4 until pin=0 (not valid tag number).

Step 4: Initially all pin value set equals to low.

Step 5: if Pin=1 (if valid tag detected) go to step 7.

Step 6: Else if pin=1 (by Voice Command) sends SMS go to step 9.

Step 7: check valid (if tag detected first time) sends student entrance SMS to parents. go to step 9.

Step 8: check valid (if tag detected second time) sends student exit SMS to parents.

Step 9: Stop.

VI. RESULTS AND DISCUSSION

To test the proposed Child Safety prototype model is shown in figure 2. The functionalities 120 samples where considered. The accuracy of pressing button by the child and detecting valid tag number by RFID Reader to send proper SMS to their parents mobile is measured to 100%. Parent device android app give result 100% accuracy. Proposed system parent smart phone get all alert SMS send by Child Safety Device shown in below figure 3.



Figure 2. Child safety prototype device

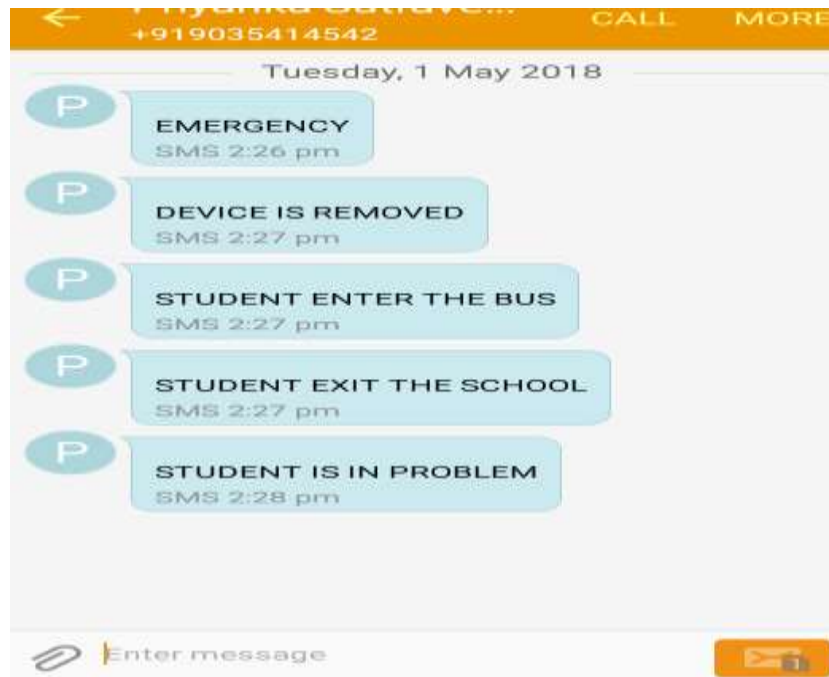


Figure 3. Alert messages

Voice recognition accuracy of the proposed system was measure on 100 samples the result of test is shown by Table.1 with Confusion matrix. The accuracy of the Voice Recognition module is measured 100%.

Table. 1 Confusion Matrix

Sample	TP	TN	FP	FN
S0	10	0	3	1
S1	9	1	2	2
S2	8	2	1	3
S3	10	0	2	2
S4	10	0	3	1

TPR = True Positive Rate, FPT=False Positive Rate, TNR= True Negative Rate, False Negative Rate.

$$Recall = Sensitivity = \frac{Number\ of\ True\ Positive}{Number\ of\ True\ Positive + Number\ of\ False\ Negative}$$

$$Specificity = \frac{Number\ of\ True\ Negative}{Number\ of\ True\ Negative + Number\ of\ False\ Positive}$$

$$Precision = \frac{Number\ of\ True\ Positive}{Number\ of\ True\ Positive + Number\ of\ False\ Positive}$$

Table. 2 Showing Recall, Precision, Specificity for voice module

Samples	Recall	Precision	Specificity
S0	0.9	0.76	0

S1	0.81	0.81	0.3
S2	0.7	0.88	0.6
S3	0.83	0.83	0
S4	0.9	0.76	0

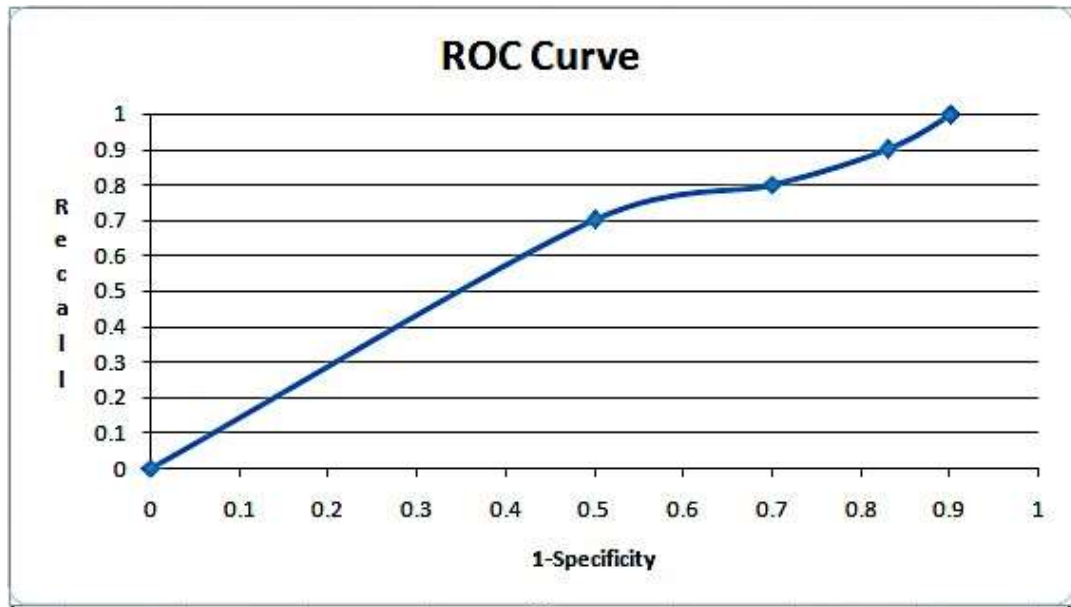


Figure 3.Receiver Operating Characteristic Curve

VII. CONCLUSION AND FUTURE WORK

We proposed safety solutions for school children. Which is capable of providing security children during the journey from home, school enter bus and exit bus, and also if they are in school premises. Parents can monitor and get information all the time without disturbing child or schoolteachers. If something goes wrong with child, child can ask help simply by pressing button or by voice command. Alternate are provided for child convenience to interact with parents.

The device is not only applicable for school children security but also women one who work late night, Elderly persons, Baby monitoring etc.

Further, adding area range can extend the work. Which helps parents to take action quit early.

ACKNOWLEDGEMENT

This project required a lot of guidance from many people for successful outcome. I would like to thank my Head of Department, my PG Coordinator and my management of PDACE for providing me all facilities and support and special thanks to my guide for their all support.

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