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Android Controlled Surveillance Robot Using Firebase

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ABSTRACT: Live video streaming is the most challenging task in the field of surveillance, as it is not highly secure and the data usage is considerably more. Though, Firebase, being a secure cloud platform, live video streaming using its real-time database hasn't been done yet. Hence, we created an algorithm called "FIREBASE-LVS" for live video streaming through Firebase. A surveillance robot has also been developed, which is controlled with the help of an android app to stream live video using this algorithm, thereby ensuring high security and low data usage.

KEYWORDS: Real time, database, surveillance, android app, data consumption reduction.

ABBREVIATIONS: LVS – Live Video Streaming, GPIO – General Purpose Input Output, IDE – Integrated Development Environment, FCP- Firebase Cloud Platform, RTD

I. INTRODUCTION

Nowadays, many technologies are available for data transmission and a lot more are under research. As technologies increase, the threats which are also the intelligence of hackers too got increased. Thus, the security of data transmission becomes a matter of question, whereas it is the most important requisite for surveillance applications. In [1], a surveillance robot is controlled using a webpage. The robot has an USB camera connected to Raspberry Pi to capture the video and that Raspberry Pi is made to act as a server, which hosts the captured video in certain IP, which is accessible to anyone having that particular IP. Thus, the security is not guaranteed. In [2], the obtained data from the camera is sent to the android app using MJPG streamer which consumes large data usage while streaming video through internet. When live HD video is sent to cloud, there it consumes more data for further processing as in autonomous cars. Thus security and amount of data usage are the important characteristics to be considered in case of live video streaming using surveillance robots. To meet those characteristics, we have developed an algorithm, which will be based on FCP. Firebase offers lot of technologies to the developers like RTD, Data storage, ML kit. RTD are otherwise called as real time database. Firebase is one of the best platform to offer a database which can be able to retrieve the data in real time without any delay in the end device. In order to develop a surveillance robot we need to establish a secure connection between the robot and the controlling device, that's the main issue in previous surveillance robots which are developed using Raspberry pi or Arduino. In this we overcome that problem by establishing the connection between the robot and the controlling device to transfer the control signals and the video streaming through Firebase Real time Database. The reason why firebase is secure, it creates a SSL link. Thus the connection is host to server and server to client encrypted. In this we are using raspberry pi to get live video from the usb camera. Then we preprocess the data and encode that data then sends the data to real time-database of firebase and retrieved the data to an android app using our Firebase-LVS algorithm. Here we are using an android device as a controlling device, for that we are using an android app which we developing using android studio and flutter SDK. The control signal was retrieved in raspberry pi from firebase using a python program and sends that signal data to Arduino via GPIO. Then Arduino process the control signal and controls the motors of the robot to create a motion.. By using our Firebase-LVS algorithm we can able to stream a live video in firebase. In Firebase-LVS, the data consumption while streaming live video was reduced slightly. The robot also has sensors like bmp180 to detect the pressure, temperature and humidity.

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During a rescue missions we don't know the exact current climate situations for those places first we can send our robot to surveillance the area and find whether the environment is suitable for us to send a human for the rescue operation. Using those attributes we can predict the weather of the place which the robot is under surveillance, we can use this during rescue operations.

The rest of this paper contains, Section II has the over all hardware implementation. Section III, holds the overview of various software's used and the implementation of Firebase-LVS algorithm. The result and the conclusion was discussed in the section IV. In section V, future enhancement of this project was discussed.

II. LITERATUR SURVEY

In [1], a surveillance robot is controlled using a webpage. The robot has an USB camera connected to Raspberry Pi to capture the video and that Raspberry Pi is made to act as a server, which hosts the captured video in certain IP, which is accessible to anyone having that particular IP. Thus, the security is not guaranteed. In [2], the obtained data from the camera is sent to the android app using MJPG streamer which consumes large data usage while streaming video through internet.

III. HARDWARE IMPLEMENTATION

To develop a surveillance robot we are using raspberry pi as a core controller, usb camera is being used to get video for live streaming. The camera was interfaced to the raspberry pi. In order to control the forward, backward, right, left motions Arduino uno was used. From Arduino the motor was driven using L293D motor driver. The control Signals to Arduino is from the raspberry pi. Raspberry pi sends those data to Arduino through GPIO ports. The Robot is powered using 1800mAh LiPO battery with 5v as output. A 12v external battery was used to drive motor. Fig.1 shows the general block diagram of android controlled surveillance robot using firebase. The detailed view of hardware and how it is works in our project is discussed below.

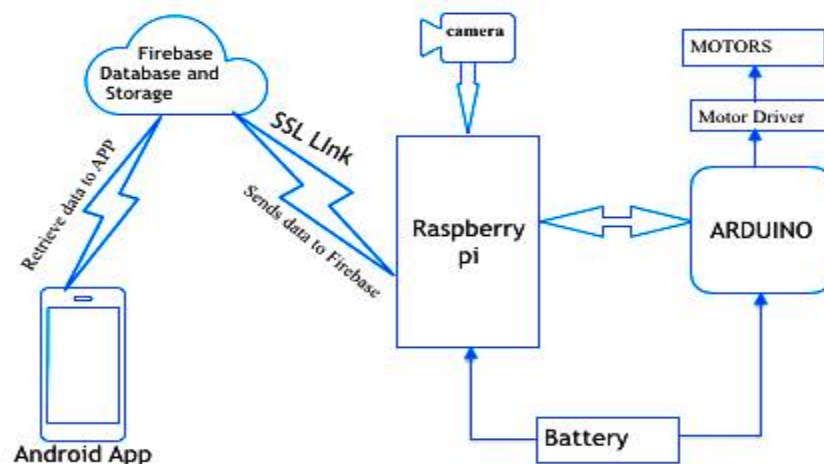


Fig.1. Block Diagram

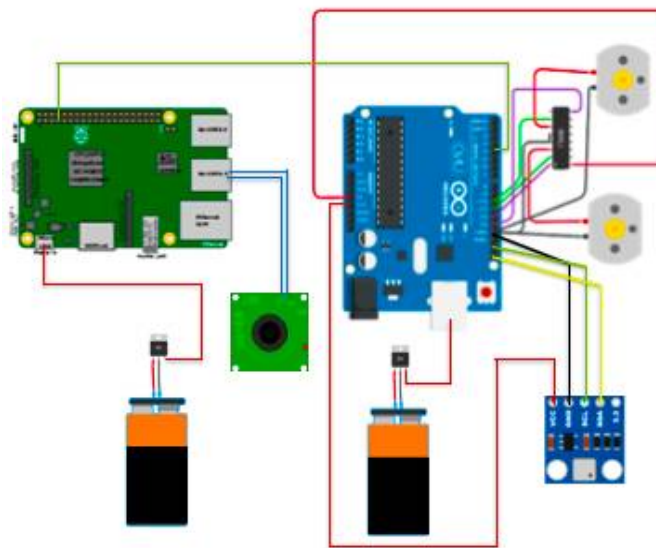
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A. Circuit Connections



II. Fig [2] Circuit Diagram

As shown in Fig[2], Dc motors connected to the Motor driver L293D. The enable pin 1 and pin 2 of L293D was connected to the pin 12 and 13 of Arduino. Pins 11 and 10 of Arduino gives input to the input pins of L293D. When then enable signal is high then only the motor driver accepts the input from the Arduino. Then the out pins of L293D was connected to the dc motors. The input input for Arduino was given by raspberry pi via GPIO to pin 4 of Arduino. Raspberry pi and Arduino has 1800mAh battery for power supply.

A. Raspberry pi

Raspberry pi is a small single on chip cpu which was powered by the 1.2Ghz Broadcom processor and it has 4Gb of RAM. It also has 40 GPIO pins to interface with sensors and other components. We are using raspberry pi as a core controller of the robot. Raspberry pi was interfaced with a usb camera and an Arduino. The core program was developed in python 2.7 and it runs on raspbian jessie OS. The internet connection is required for raspberry pi to connect to Firebase cloud. So we used inbuilt wifi module of raspberry pi to connect the internet. In order to process the video we need high processing power than arduino and other micro controllers hence we go for Raspberry pi.

B. Arduino UNO

Arduino is a development board with Atmega micro controller. Even though Raspberry pi has high processing speed, its not enough to handle multiple operations at a same time. So we used Arduino to handle the motion and bmp180 sensor alone. The robot motions are controlled by the Arduino. Input to Arduino is sent from raspberry pi via GPIO pins. Then the Arduino process the data and gives output to the L293D motor driver to enable the respective motors. In additionally to measure the temperature and the pressure we use BMP180 sensor. The Algorithm which we use in arduino is explained in section III.

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D. L293D Motor driver

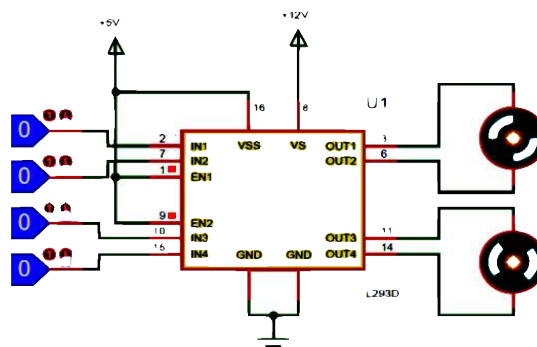


Fig.3. Motor driver circuit

Fig.3 shows the motor driver circuit to drive the motors using the arduino signal. Arduino gives only 3.3v as output but a dc servo motor requires 12v. Hence we can't directly drive the motor from Arduino. In order to do that we used L293D IC.

IV. SOFTWARE IMPLEMENTATION

A. Android Studio to develop an Android App:

To control the Robot we used an app which was developed in Android studio. We are using flutter SDK framework to develop an app in Android studio. We use dart language to program the app to interface with firebase to send control signal data to robot via firebase. And to retrieve the video data to an app. A secure Authentication of user is done on firebase so that authorized person only able to retrieve the surveillance data and he only able to control our robot.

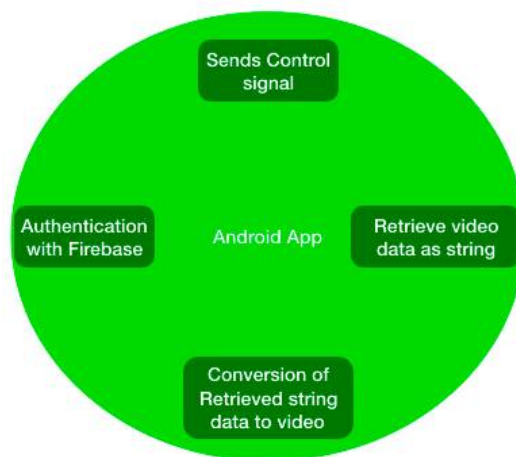


Fig.4 Android App - Operation Outline

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B. Arduino IDE to develop a Code for Arduino

This IDE is used to develop source code for Arduino boards. The programming languages used in this IDE is Embedded C. It is the high language used in embedded system development.

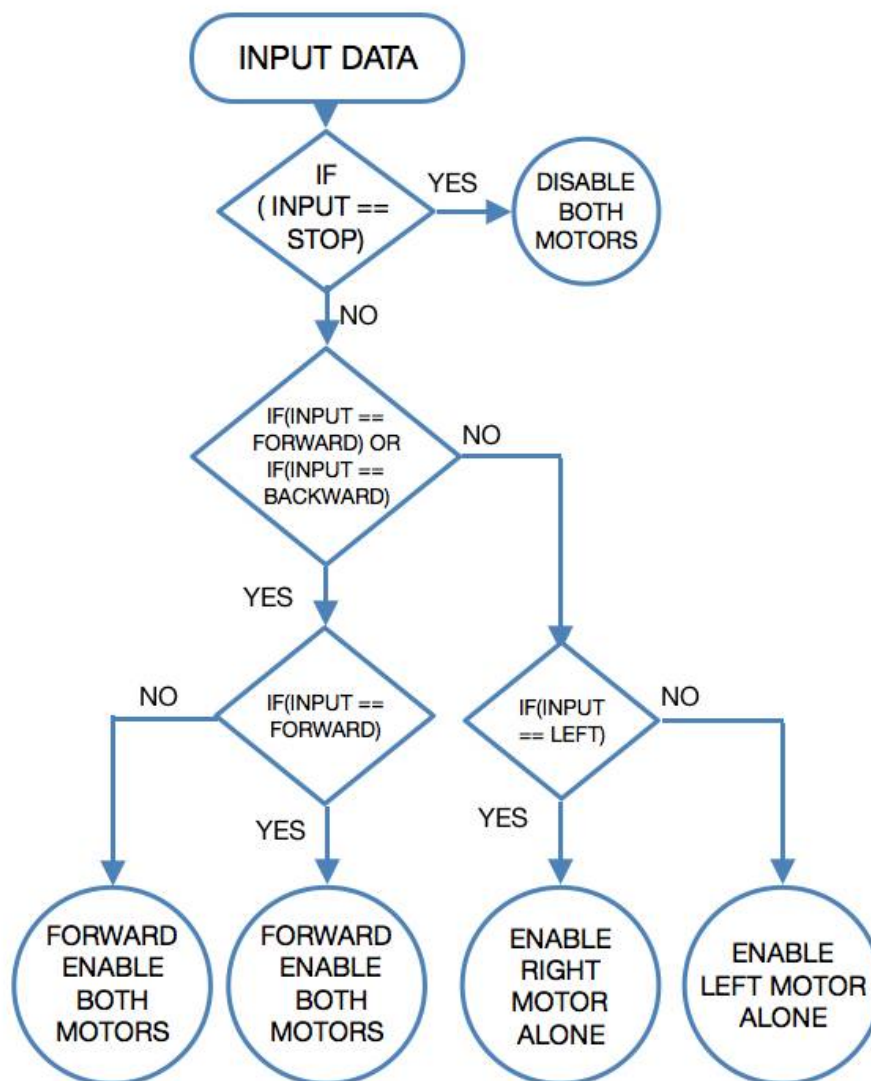


Fig [5] Arduino UNO Program flow chart

Fig [5], shows the operational flow of the Arduino program which we developed to control the robot. The program first checks the input, if it is stop command then both motors value is set to low. Hence there will be no motion. If the input was not stop then the algorithm will check whether its is forward or backward or left or right. Based on the input motors are enabled. For left turn stop the left motor and run the right motor. To make right turn vice versa.

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C. Firebase-LVS Algorithm:

Fig[6], shows the Firebase-LVS algorithm which we developed to do stream a video in real time. In this algorithm the input data was from usb camera. In python program with openCV the input video was processed and gives the frames of the video. In preprocessing the video saturation is increased using openCV. Then these frames are encoded to a specific format and then it uploaded to the firebase from python using firebase-python library. Then the uploaded data was retrieved in the android app which we developed. The received data will be in string format from firebase. So we have to decode the data to video format. Firebase is a secure cloud platform maintained by google. Firebase has a real time-database which can used for live streaming of data. Using this, a data which was uploaded to cloud database can be retrieved in real time. Real time video stream is not done in firebase, only post video stream or delayed video stream only made in firebase. The reason for that is firebase accepts string data only. So we came up with an idea to implement the base64 encoding technique for firebase. So we encode each frames of the video into base64 string. Then we upload those base64 string to firebase Real time Database. In the client side that is android app, the base64 string of the frame of the video is retrieved using dart programming. Then the retrieved base64 string in converted into JPEG image and it was streamed in a image viewer. As the new frames being retrieved from firebase every seconds the old frame in the image viewer is replaced with the new frame, thus its forms a video like motion. In the app the each frames are processed to find is there any faces detected in the video before it was sent to image viewer. So that while surveillance or rescue mission if a human face detected it gives a notification in our android app.

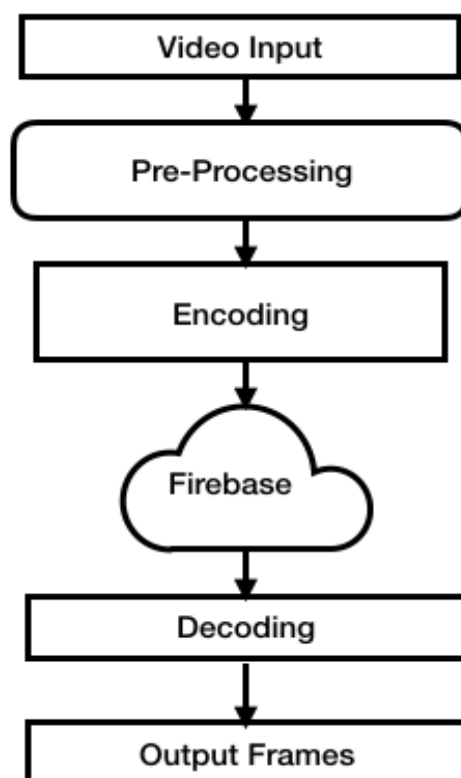


Fig.6. Firebase-LVS Algorithm

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V. RESULT AND CONCLUSION

Fig.7. Hardware

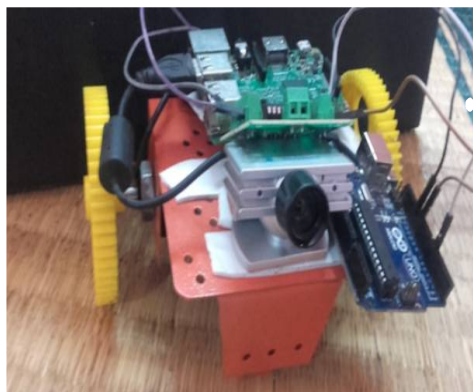


Fig [7] shows the hardware connections of a surveillance robot which we developed. In this we use an arduino, raspberry pi, a camera, to capture the video to stream and 150 RPM motor is used for motion.

Fig.8. Android App

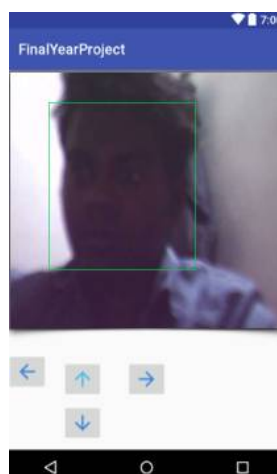


Fig [8] shows that, the live video was retrieved to the android app using firebase. By using Firebase-LVS algorithm the data consumption was reduced by 1% as compared other streaming algorithms which have currently using

In this, we successfully developed an algorithm to do LVS via firebase. We used that algorithm to develop a live video surveillance robot and we developed an android app to control the robot through firebase. Even though firebase is

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mostly used for web development and app development but we successfully implemented and proved that we can even develop robotic applications using firebase

VI. FUTURE ENHANCEMENT

This system can further be developed by interfacing LORA-WAN technology, using lora-wan technology the robot can wirelessly communicate and controlled between 50kms of radius from the LORA WAN gateway. And it can able to host Internet upto 50kms wirelessly from the LORA-WAN gateway. So that we can remotely operate our surveillance robot for disaster rescue operation when humans don't know is it safe to send a person for rescue.

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