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Anti-Hijacking system using Raspberry Pi

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***Abstract*—With the increase in population, the time taken for the commute from one place to another is extremely important. As such, air travel has been the most preferred mode of transport due to its ability to cover large distances in short periods of time. As a result, it becomes very important to ensure the safety of passengers. As seen in a few instances in the past, lives have been put in jeopardy and extensive damage has been done both in terms of capital and people. We propose a proof of concept for an anti-hijacking system based on the ubiquitous RFID technology.**

I. Introduction

In recent times, with the increase in population and due to development in many areas the mode of transportation are very diverse. With increasing traffic and the need to cover large distances at very short notices and in less time is very crucial,air travel is the most preferred. Due to this, the number of aircrafts used or deployed is immense and it becomes important to secure the passengers. Anti-hijacking is of utmost importance in today's world. In most situations where hijacking takes place, the hijacker targets the pilot. Demands are usually then made and passengers are held as collateral while negotiations take place. Flights are generally diverted away from their expected route. The idea is that tag will be accessible to the crew. These tags are small enough to be concealed or hidden from view. The crew is generally asked by the hijacker to move away from the passengers and are forced to stay at the front and back end of the plane. The RFC522 or the RF receiver will be placed at the front and rear of the plane.The process can be optimized by optimum placement of tags in the future[6]. If the tags that are carried by the crew are detected simultaneously, for a period of more than 10 seconds, then control is taken away from the pilot and the plane switches to autopilot. In the future with some modifications,the aircraft can then follow a program inbuilt into the plane and decide which airport to land the plane at. This entire procedure is designed to minimize the damage that the aircraft would have otherwise caused in the event of a hijack.

In this paper discuss the components used to create an anti-hijacking system, software used to interface the components,interfacing between the components and the algorithm based on which the system works.The entire system works on the basis of RFID technology[11-12].

II. Components Used

Raspberry pi 3B, Joy stick, ADC-MCP 3008, RFID RC522 and Servos are the components used in the anti-hijacking system.

A. Raspberry Pi 3B

A single compact computer board is used to implement the codes and run the system. The Raspberry Pi 3B was used for its ability to handle GUI ,it gives far better performance than its previous versions for the 32-bit mode[7].The unique ID numbers are also of 32 bit. The Pi 3 is preferred for its wireless applications for Wi-Fi and Bluetooth and is very economical[8]. The model is capable of running multiple applications and games as well and can be used for a variety of purposes. The 3B model of the Raspberry Pi is open source and has Linux embedded in it. This micro controller is selected because of it's low cost, simplicity, high ability of programming and dealing with various software and hardware applications.

B. Joystick

The two-axis joystick is a combination of two potentiometers as a switch. Whenever the joystick is moved in an axis the corresponding potentiometers resistance will vary and the output voltage will change accordingly. The joystick can move in two axes and has five pins. It can accept 5V input (VCC and GND) and output the potentiometer output in two pins (Ver and Hor) and status of the switch (Sel) in one pin. The voltage output from the joystick can be used to detect the position of the joystick. Since the output of the potentiometer is an analog one, we need to use an analog to digital(ADC) converter.

C. ADC-MCP 3008

The GPIO pins on the Raspberry Pi are digital in nature. As such, interfacing any analog components becomes difficult. The MCP3008 helps convert analog signals to digital ones. The joystick gives out a signal that is analog in nature. The converter in nature, now comes the use of MCP3008 which converts the analog signals from the joystick to digital signals and sends them to the Pi. The MCP3008 is a 10 bit and 8 channel micro-controller. For this device, reference input and analog input voltage has a direct relationship. If the reference voltage is denoted by Vref, then the sensitivity of the device (otherwise denoted by the LSB) is given by

$$LSB = Vref/2^n \tag{1}$$

where n is the number of bits.

In our case,

$$LSB = Vref/1024 \quad (2)$$

The SPI bus protocol is used by the MCP3008 which is supported by the Pis GPIO header.

D. RFID RC522

RFID (Radio Frequency Identification) technology is very economical and easily available, they are widely used in a variety of applications that range from id tracking for train station, vehicles, pets, to access control for sensitive areas[1,10]. It behaves as a dual mode(two way) system that employ a wireless system (transmitter and receiver). A basic RFID system can be separated into two parts tag and a reader[9].Every tag has a unique ID number. The reader stores different ID numbers and only when the tag comes in proximity to the reader, the tag will be detected if that particular ID number is stored in the database of the reader.

The RFID tag operates in the 13.56MHz RF range uses a unique 32-bit identification number. It is not re-programmable. Due to its low cost,it has been used in a variety of applications. It consists of an ic that is capable of both reading and writing. It is used in several applications, especially in wireless systems due to its low cost. The requirements to operate the device are easy. It needs a low voltage and is available for a very low cost.

E. Servos

Servos work on the principle of pulse width modulation.The frequency and width of the incoming pulses determine the speed and direction in which the servo moves[5]. The magnitude of pulse and frequency are the parameters to be considered. The device is widely used in robotic applications.

III. Software Used

A. Python - A general purpose scripting language

B. Qt and PyQt - A python module that can be used to develop GUI

C. All the other modules to access the hardwares

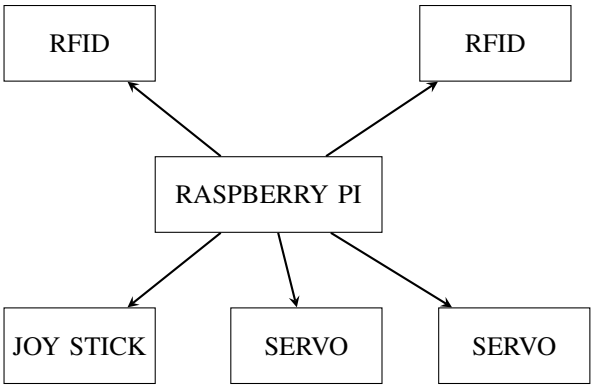
D. Raspbian - Operating system of the Raspberry Pi

IV. Interfacing between the Components

The Raspberry Pi was used as the mini computer and was interfaced with the other components. The components used are the RFID sensors and the MCP3008, joystick. The interfacing is first done with the RFID (RFC 522 sensors)[4]. The idea behind this is that the RFC 522 sensors will work simultaneously. Both sensors are connected such that if the tag is detected, the LED that is built into the sensor will glow.

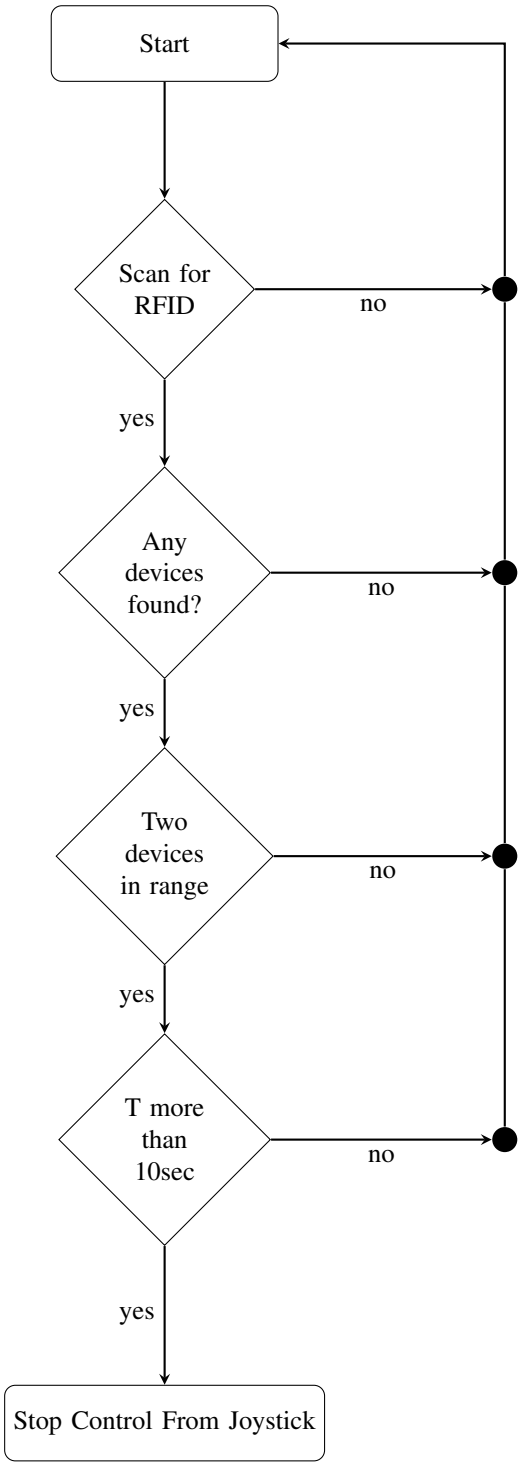
The Raspberry Pi is also interfaced with the MCP3008, which is a joystick and it also has an inbuilt ADC converter in it. This in turn has been interfaced with the two servos. The servos as stated in this paper, work on PWM (pulse width modulation). On the condition that the control is in the system (without the simultaneous detection of the tags by the RFID sensors), the Raspberry Pi sends signal to the joystick. During this process the output of the joystick is in the analog form and so when it goes to the MCP the inbuilt ADC (analog to digital converter) converts the signal to digital form. This digital signal is then sent to Raspberry Pi from where it is again sent to the servos. The width of the digital pulse(signal) decides the degree of rotation of the servos. The frequency of the digital pulse impacts the speed at which the servo rotates. We have two servos, each servo correspond to the motion of an actual aircraft. One servo corresponds to the elevation of the plane while the other corresponds to lateral movement. These are further also graphically represented on the Graphic User Interface (GUI) of the Pi. The movement for each servo has been denoted by the graphic dynamically changing servo. When the servo is subjected to even the slightest of change or movement, the same changes are reflected on the graphic interface. This feature has been incorporated in order to demonstrate the effect of the anti-hijacking concept.

V. Block Diagram



VI. Algorithm

The below flow chart explains about the type of algorithm used for the working of anti-hijacking unit. It is built using the Raspberry Pi as a mini computer and is coded is mainly done in Python. The flow of control is such that, the control will be disabled if the RFID tags are detected for an extended period of time (this time limit can be pre-set). However, our condition states that both the tags have to be concurrently detected. The control will stay manual as long as the condition is not met. Once the tags are detected, control is cutoff from the pilot and manual input will not affect the joystick. Manual input is not allowed as liability decreases.



VII. RESULTS

As demonstrated by this paper, the servo graphics on the screen dynamically change when the servos are subjected to pressure or any movement. This indicates that the pilot in charge of the aircraft and is at his/her control at all times. However, when the flight attendants that are carrying the tags come in proximity with the RFC 522 sensors which are placed at the front and rear ends of the plane, the control gets locked out. This means that when the joystick is moved , the servos

	Rf-ID(Front)	Rf-ID(Rear)	Control	GUI
Detection	No	No	Pilot	Enabled
Detection	Yes	No	Pilot	Enabled
Detection	Yes	Yes	Disabled	Disabled
Detection	No	Yes	Pilot	Enabled

Fig. 1. Results

interface(graphic) do not respond at all. So the changes in the joystick do not have any effect on the servos(no movement).

This means that the system has now taken an anti-hijacking measure. This is done so that the hijackers do not try to take complete control of the plane. This can lead to very heavy loss of life and capital in such a case. So if the hijack has occurred, the pilot can no longer be forced to redirect the plane. So, the pilot has been locked out. This system can revert to a pre-programmed setting decided in advance.

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