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Embedded Motorcyclist Safety Ensurance System

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Abstract - *The main goal of the project is to design a smart system to avoid accidents in order to ensure driver safety. Camera will be used to check whether the driver is wearing a helmet or not using python scripts. Here, object detection will be through image processing and SIFT algorithm. If the person is not wearing a helmet, a signal is generated that can be used to not start the engine. Therefore, the bike won't start in order to ensure that the rider can drive around and only if he is wearing a helmet. This system can also help provide quick assistance to accident victims. When the driver has an accident, the sensor recognizes the state of the motorcycle and reports the accident. Then the GPS on the bike sends the place where the accident happened to one pre-registered account over e-mail, so that medical assistance can be sent with immediate effect. This ensures the safety of drivers.*

Key Words: **Python, SIFT, GPS, Helmet Detection, Accident, Motorcycle**

1. INTRODUCTION

In this project, a structured modular design method was adopted. This system is developed due to the reason that bike accidents increase day by day and cause the loss of many lives and there is a need to reduce them. By wearing a helmet, lives lost due to accidents can be greatly reduced. Today, an estimated 1.2 million people lose their precious lives in traffic accidents due to carelessness of drivers who don't wear helmets. In everyday life, many accidents occur that must be sought to find a solution. Statistically, one of the main contributors to the death rate in India is the increasing case of traffic accidents, and the main contributor is the carefree attitude of bikers to the importance of helmets. For this problem, a practical solution is needed to ensure driver safety. So to overcome all these problems, there is an important criterion verified by "Embedded motorcyclist safety ensurance system" before the bike starts. First, check if the rider is wearing a helmet and not just keeping it. Second, when a person encounters an accident, the person's location will be traced using GPS and then send to nearby hospitals using email.

The microcontroller used in the project is the Renesas microcontroller. The Renesas control board consists of a microchip, power supply, capacitor, recorders, LCD to show the values and pins to connect the sensors. The microcontroller is the core of this task. It is the CPU of the circuit. The microcontroller communicates with the server. To implement this project, the Renesas R5F100LEA RL78 series microcontroller was used, which is a 16-bit microcontroller

2. RELATED WORKS

Fan Wu et al. [1] proposed a paper in 2018 that refers to the Dense network and modified the backbone based on YOLO V3.

Dharma Raj KC et al. [2] developed a helmet violation detection system in 2018 with accuracy of 90%. It was concluded that depth of CNN matters more than the width and the small models can be effective even without GPUs. They observed errors when a motorcyclist was wearing a hat or when the front rider is wearing a helmet and the second person is not.

C. Vishnu et al. [3] proposed a model based on the detection of motorcyclists without helmets in videos using CNN in the year 2018, where the proposed framework for automatic detection of motorcyclists driving without wearing the helmet makes use of adaptive background removal which is invariant to various challenges such as illumination, poor quality of video, etc.

Pathasu Doungmala et al. [4] described a real-time vision-based helmet wearing monitoring system in 2013 that can be used to detect in a sequence of images. The system used a moving object detection method and resolved full and half helmet problems using a proposed full and half helmet detection and segmentation method.

Kunal Dahiya et al. [5] in 2014 proposed a framework for real-time detection of traffic rule violators who ride bike without using helmet. Proposed framework also assists the traffic police for detecting such violators in odd environmental conditions viz; hot sun, etc.

Yuki Sakai et al. [6] proposed an object detection and tracking system which is based on Scale Invariant Feature Transform (SIFT) and Speed Up Robust Features (SURF) feature extraction methods in 2015.

Heena R. Kher et al. [7] developed an Image matching and registration method that is invariant to scale, rotation, translation and illumination changes in 2014. The method is named as SIFT.

Thepnimit Marayatra et al. [8] proposed a model on Motorcyclist's Helmet Wearing Detection Using Image Processing in 2014, where, a simple moving object detection is adapted to identify vehicles which in turn is identified whether it is a motorcycle or not then to identify whether the motorcyclist is wearing a helmet or not.

Yu FAN et al. [9] in 2014 focused on the helmets' detection based on video processing when the operator is entering the training ground.

Romuere Silva et al. [10] in 2014, proposed another approach to the Helmet Detection on Motorcyclists Using Image Descriptors and Classifiers.

Romuere Silva et al. [11] in 2013 proposed a model on Automatic detection of motorcyclists without helmet , which can be divided into three sub sections, namely- vehicle Embedded Motorcyclist Safety Ensurance System segmentation from frames of the video, vehicle classification and helmet detection.

Zhu Daixian et al. [12] proposed a paper on SIFT Algorithm Analysis and Optimization. The analysis of feature extraction can be used in the intelligent computing of this algorithm.

3. DESIGN AND IMPLEMENTATION

In this section the proposed system is explained in detail.

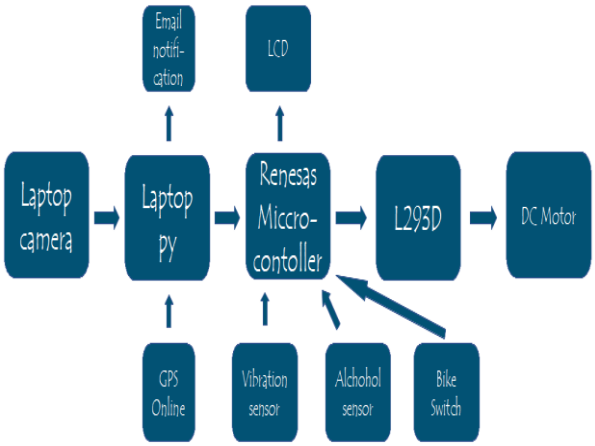

Fig-1: Proposed Block Diagram of System

The proposed system consists of Laptop which is to substitute the camera to be installed on the motorcycle. The laptop also runs the image processing codes and is responsible for the identification of the presence of the helmet, and further pass on the respective value to the Renesas micro-controller. A Renesas micro-controller is present connected to the laptop, vibration sensor an alcohol sensor and a switch which is used to initiate ignition. It is also connected to a LCD to prompt respective messages to the rider. This system is thereon connected to the L295 which is responsible to drive the motor hence indicating ignition of the motorcycle.

Renesas is a 16bit micro-controller with 16 to 512KB of ROM and 2 to 32KB of RAM and an on-chip high speed (32 MHz to 1 MHz) as well a low speed (15 KHz) oscillator. Also contains a 10bit resolution A/D converter. It has totally 3 UART for Serial Interfaces and totally 0-7 channels for timer with built-in PWM features. Cost is comparatively less. Rigid body and hence less prone to damages due to electrostatic charge. Operates with 5v power supply. Comes with a General-purpose register: 8 bits × 32 registers.

L293D is basically a motor driver or controller. It has two built-in H-bridge circuits which can control two DC motors simultaneously in both clockwise and counter-clockwise direction. It acts as a current high amplifier because it take low current signal at its input and provides higher current signal at the output in order to drives different load e.g stepper motor & DC motors. Its features include a large input voltage supply range, large output current high noise immunity input signals etc.

4. EXPERIMENTAL SETUP

As per the needs of the proposed system, the requirements consist of:

A] Hardware Requirement: Renasas Micro-controller, L293D motor driver, DC Motor, Alcohol Sensor, Vibration Sensor, LCD, Laptop, Webcam / laptop camera, Switch.

B] Software Requirement: Flash Magic, Flash programmer, Python 3.7, Python-Libraries (OpenCV, Numpy, Smtplib, Geocoder, Serial, Sys, etc) , CubeSuit+.

The equipment would be connected as shown in the fig1 and would require the program loaded laptop to be set up. Once all the controllers are loaded with the programs, it would require a person to face the camera and try to start the bike, in the case, turn the switch on and based on the conditions met, the motor would run or fault would be displayed on the LCD

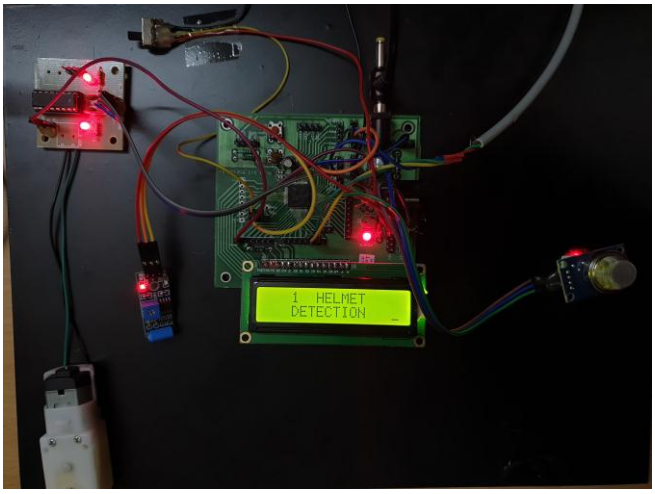

Fig-2: Hardware Setup for the Experiment

5. IMPLEMENTATION

The Experiment flow has the following series of steps:

A] Hardware Setup - The hardware components are arranged on to a component board as per the architectural block diagram with the LCD being mounted to the renesas microcontroller and the other sensors such as the alcohol sensor and vibration sensor being connected through the other pins and the motor connected through the L293D motor driver.

i] Renesas Programming: The Renesas microcontroller is the core of hardware controller and all the additional devices are connected through it and hence we have to set up all its ports and pins and program them as input or output ports respectively, which is achieved by the help of CubeSuit+.

ii] Condition Check: The main purpose of the project is to permit conditional ignition of the motorcycle engine which is achieved by a C program with looping condition checks for each required feature and its concerend threshold values. The renesas code is responsible for driving the motor. It is dependent on the the alcohol sensors reading being below 80 units indicating safe levels of alcohol presence and the value of the vibration sensor to indicate an accident. This code is dumped into the renesas microcontroller.

B] Helmet Detection - The helmet detection part is the most important criterion of the bike ignition and is achieved by a simple python program using an image matching algorithm, SIFT Algorithm, in this case with the aid of a camera, here the in built laptop camera. The training data images stored for comparison. On attempt to ignition the port linking the laptop to the renesas control behaves in sender mode where on the occurrence of a match the python program generates a signal to the renesas control regarding the match and approves the requirement of the helmet for riding.

C] Motorcycle Ignition - The motorcycle ignition, here represented by the switching on of the motor, occurs when all the prerequisite conditions are met, being the alcohol levels below threshold and the presence of the helmet and the bike ignition being switched on. At the same time the motor is also switched off as and when one of these conditions are not met or in the event of the occurrence of an accident.

D] Accident Detection And Intimation - The vibration sensor helps detect accident when there is persistent vibration beyond a threshold, it intimates the renesas control which turns the bike off and further intimates the python program regarding the same where now the port behaves in receiving mode and on getting intimated regarding the accident, uses geocoder library and stores the location co-ordinates in a file and later uses a smtp server object to send a mail to a pre-registered email ID consisting of the co-ordinates of the accident immediately.

6. RESULTS

The results showed that after the program was loaded and laptop was set up and once all the controllers were loaded with the programs, a person was made to face the camera and he tried to start the bike, in the case, turn the switch on and based on the conditions met, the motor ran or fault displayed on the LCD.

Every time the camera attached to the motorcycle or in the experimental case, the laptop camera, captured an image, the same set of steps were repeated and proceeded for analysis and hence confirm the presence or absence of a helmet with the motorcyclist. Hence ensuring that the bike starts only when the motorcyclist is wearing a helmet and otherwise it prompted a suitable message when attempted to start the bike.

The requirements of the safety were ensurance of criteria which is essential for the bike ignition and to ensure that the motorcyclist is not under the influence of alcohol that may prove harmful while riding. This was achieved with the help of an alcohol sensor which when one breathed into returned the level of alcohol present in the breathe sample and hence this value could be used to administer the level be under a certain threshold value which would not prove harmful, exceeding which an appropriate message be displayed when attempted to start the bike.

When the above mentioned two criterions met, the Renesas micro-controller received the right values and the bike ignition turned on. From here the motorcyclist was considered safe under the above conditions.

The system also succeeds in intimation of an accident, as on the event of an accident triggered by the crossing of a threshold value on the vibration sensor, the system immediately switches off the motor and sends the geo co-ordinates of the accident to a registered account over mail.

7. CONCLUSIONS

The project succeeds in providing satisfactory results and hence shows as to how basic safety features can be embedded with the very motorcycle. The proposed system ensures that the motorcyclist is under the safety conditions to be riding and intimates the same if found in violation of the same. The system also succeeds in intimating an event of an accident with the location co-ordinates of the same. The system goes to show that there are more efficient methods of ensuring rider safety than those that already exist and would help levy the otherwise heavy fines and penalties imposed for safety rules violation whilst not even ensuring rider safety in actuality.

8. FUTURE WORKS

The proposed system currently manages to achieve the basic safety features efficiently, but presently is applicable just for the primary rider or the driver. Hence going on further it would prove more powerful to enforce the same set of rules for the pillion rider as well. The current system can also be enhanced by making the accident location co-ordinates more accurate with the help of more powerful modules. Also living in this era where the only constant is the evolving technology, there will be a constant search for a

better and more powerful method of implementation of the same modules and make it rather more efficient.

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