Weight Sensing Automatic Gate

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ABSTRACT

With the help of science and recent advancements in technologies, smart housing can be encouraged more and Automation has played a crucial role in the development of a smart house. Securing a premise with an automatic gate adds not only ease of operation but security to a smart house as well. In this proposed project, the gate makes space according to the person or vehicle that wants to enter the premises. The images of the visitor who wants to access the gate are also captured. If the visitor matches the previously stored images on the database, then the access will be granted otherwise the gates will not open for that intruder and the image will be saved in the database for further references. This provides proper tracking and monitoring of the visitors entering any premises.

Keywords *- Raspberry Pi, Loadcell, Face Recognition.*

INTRODUCTION

A load cell is a type of transducer that converts force into an electrical signal. The signals can be measured and standardized to know the weight of any object. When the force applied to the load cell changes, the electrical output changes proportionally. The most common types of load cells are hydraulic, pneumatic and strain gauge. The strain gauge load cells are the most commonly used load cells in industries because of their high accuracy, versatility and cost-effectiveness. A strain gauge is a device that is made up of such a material whose electrical resistance changes with any deformity due to the applied strain [1]. This change in resistance is measured using a Wheatstone bridge.

The Raspberry Pi is a very powerful, small computer having dimensions of a credit card that runs Linux, but it also provides a set of GPIO (general purpose input/output) pins that allow us to control electronic components for physical computing and exploring the Internet of Things (IoT) [2]. The processor used is a Broadcom BCM2835 system-on-chip (SoC) multimedia processor.

The huge success of the Raspberry Pi boards led to the development of the Raspberry Pi camera module v1 to be used together with the Raspberry Pi boards [3]. The camera module v1 was released in the year 2013. The Raspberry Pi camera is a low-power high-definition small camera that comes with a flat flexible cable which is to be connected into the CSI (Camera Serial Interface) connector [3].

Image processing is a technology that extracts data from photos or videos. They are capable of identifying objects or people from a digital image or video frame from a video source. A facial recognition system works by comparing the facial features in each image with the faces stored within a database. It is widely being used in security systems. Other applications include advanced human-computer interaction, video surveillance,

automatic indexing of images and video databases, among others [4].

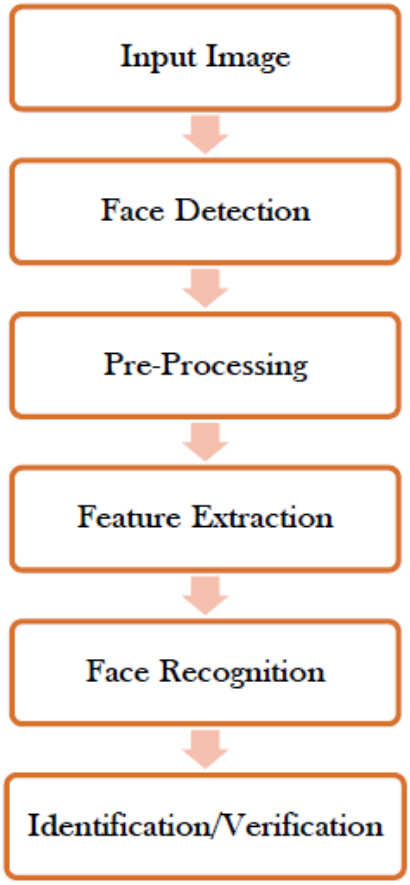

Fig 1. Basic Face Recognition Process

EXISTING SYSTEMS

Security and privacy are two main desires of any human being. To keep any private property such as a residential area, office or factory secure and free of intruders, use automatic gates proves to be the ultimate solution. Also, these gates reduce the workload and the manual work done to open and close the gates. The automation of gates had been made possible by two widely used technologies- first, the RFID and second, PIR sensors.

RFID (Radio Frequency Identification) uses electromagnetic fields to automatically identify and track tags attached to objects. An RFID tag consists of a tiny radio transponder; a radio receiver and transmitter. In the case of RFID Based Automatic Gates, the tags can be attached to the cars or can be carried by a person as an ID Card. When the tag is triggered by a nearby RFID reader device which is connected near the gate, the tag transmits digital data. This orders the gate to operate and open and close accordingly.

Another way to automate the gates is by using the motion sensors or the PIR (Passive Infra Red) Sensors which are used as motion detectors according to which the gate operates. All objects with a temperature above absolute zero emit heat in the form of radiation [5]. These sensors work based on these radiations which are emitted from the objects.

These systems have been successful in automatically opening and closing the doors. But their biggest drawback is that whenever the gate is opened, the gap created by them is the maximum *i.e.* they don't operate on the basis of the weight or size of the visitor. Even if only a single person wants to enter, the gap created by the gates will be the maximum. This increases the time of operation of the gates. Similarly, if a premise is having a driveway gate along with a pedestrian gate then these systems are not able to differentiate between which gate is to be operated.

This proposed system uses a new approach for automating the gates by using Load Cells which helps to reduce the gap created by the two gates reducing the time of opening and closing of the gates by few seconds. In addition to this, the proposed system shows the capability of being used effectively where a pedestrian gate is also available.

Combining it with Face Recognition System increases the security and functionality of the given system. By using Face Recognition System, the intruders won't be able to enter any area uninvited.

PROPOSED SYSTEM

The proposed system's working can be broadly divided into two parts. Part 1 will include detecting the weight of the visitor and selecting the appropriate gate for operation. The Face Recognition Process will be carried out in Part 2 with the help of the Pi Camera attached to the Raspberry Pi module.

Part 1: Weight Detection

Whenever a person or a vehicle will come near the gate, it will encounter a load cell. The weight will be equally distributed onto the load cell. The load cell will detect the weight of that person or vehicle. To get more accurate output, an HX711 load cell amplifier is connected. The output so obtained will be feed to the Raspberry Pi module. The next step is the selection of gate i.e. which gate will operate or at what angles will it operate. If a double swing gate, as shown in figure 2 (a) & (b), is to be operated, then it will open the gate at certain angles so that the space created by the gates between them is sufficient for a person or a vehicle to pass through it. These angles will be selected based on the total weight measured.

Fig 2. (a) & (b) Double Swing Gates

Some areas and buildings are secured with a driveway gate along with a pedestrian gate as shown in Figure 3 (a) & (b).

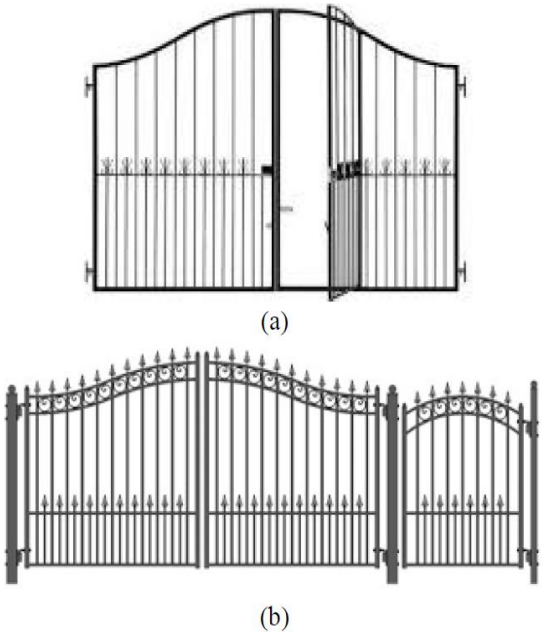

Fig 3, (a) & (b) Driveway Gates with Pedestrian Gates

A car or any other vehicle can access the premises through the driveway gate and if a person wants to enter, then he/she can use the pedestrian gate. The easiest way to operate these gates automatically is by considering the weight of the visitors which can easily be done by the load cell. Based on their weight ranges, the Raspberry Pi will be able to choose between the pedestrian gate and the driveway gate correctly.

Considered Weight Ranges

The first parameter on which the opening and closing of the gates will depend is the magnitude of the weight measured near the gates. The gap created between the two gates or the gate operated will depend upon whether the weight measured belongs to a person, a two-wheeler like a motorcycle or a four-wheeler like a car.

The weight ranges of different expected passers are given in Table 1 and Table 2.

Table 1. Human Weight Ranges

Visitor Type	Average Weight (In Kgs)
Adult Male	59.1 (Avg. Height-1.65m)
Adult Female	50.6 (Avg. Height-1.52m)

Table 2. Vehicle Weight Ranges

Vehicle Class	Average Gross Weight** (In Kgs)
Two-wheelers like Motorbikes	262-565
Cars (Compact, Midsize, Large)	1,400-2,700
Small SUVs	1,800-3,000
Large SUVs	3800-4500

***Gross Weight-Weight of a vehicle with passengers, luggage and other items.*

While the gate is being selected, the Raspberry Pi module will be performing Part 2 simultaneously *i.e.* the identification and verification of the visitor.

Part 2: Face Recognition

The Pi Camera connected with the Raspberry Pi module will be providing the necessary input to the module for performing Face Recognition.

To make the Raspberry Pi module capable of recognizing faces, it needs to be configured for the same. To do so, we need to install the OpenCV library on the Raspberry Pi module. OpenCV or *Open Source Computer Vision Library* is a library of programming functions that mainly aims at real-time computer vision. Using the OpenCV library makes it very simple to perform Face Recognition. Once the OpenCV libraries are installed in the Raspberry Pi Module, the next steps can be performed very easily.

A. Gathering Face Examples

The first step in building our face recognizer is to collect examples of each face we want to identify. These examples create the dataset which will help in recognizing the faces when they want to access the gates.

B. Training the Recognizer

After gathering all the images/faces and combining them into a dataset, we need to train the OpenCV Recognizer. The result will be a ".yml" file that will be saved on a "trainer/" directory. The LBPH (Local Binary Patterns Histograms) Face Recognizer is included on the OpenCV package.

After these two steps are implemented, the security system is ready for detecting the facing using the Classifiers. These Classifiers are a pre-trained set of data (XML File) that can be used to detect a particular object, in our case a face. OpenCV also allows us to create our own Classifier which can be used to detect any other objects in an image by Training your Cascade Classifier. The most commonly used classifier is the "Haar Cascade classifier" which is available in the OpenCV package. Now, this system is ready for recognizing the faces. Whenever a face which is saved in the dataset is detected, the gate will allow access and open. But when an unknown face is detected, no access will be provided. The combination of Part 1 and Part 2 will provide a secure weight sensing automatic gate. One half of the system works on detecting the weight of the visitor and selecting the appropriate gate to be operated. This reduces the electricity used for the operation of the gate operators even on a very small scale. The other half of the system works on increasing the security of the premises by giving access to only recognized people. The given flowcharts in Figures 4 & 5 explain this process more precisely and easily.

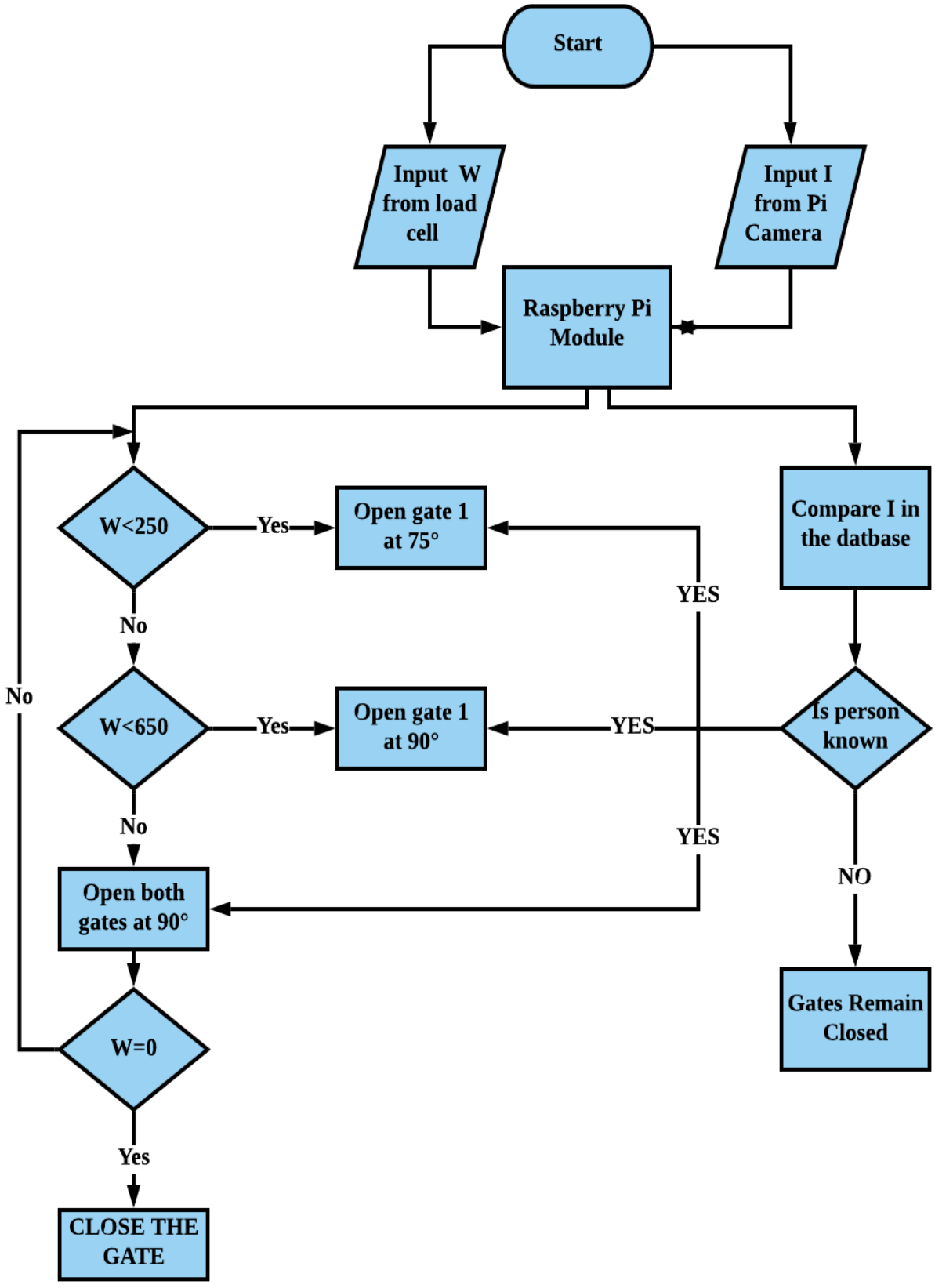

Fig 4. Operating Automatic Double Swing Gates

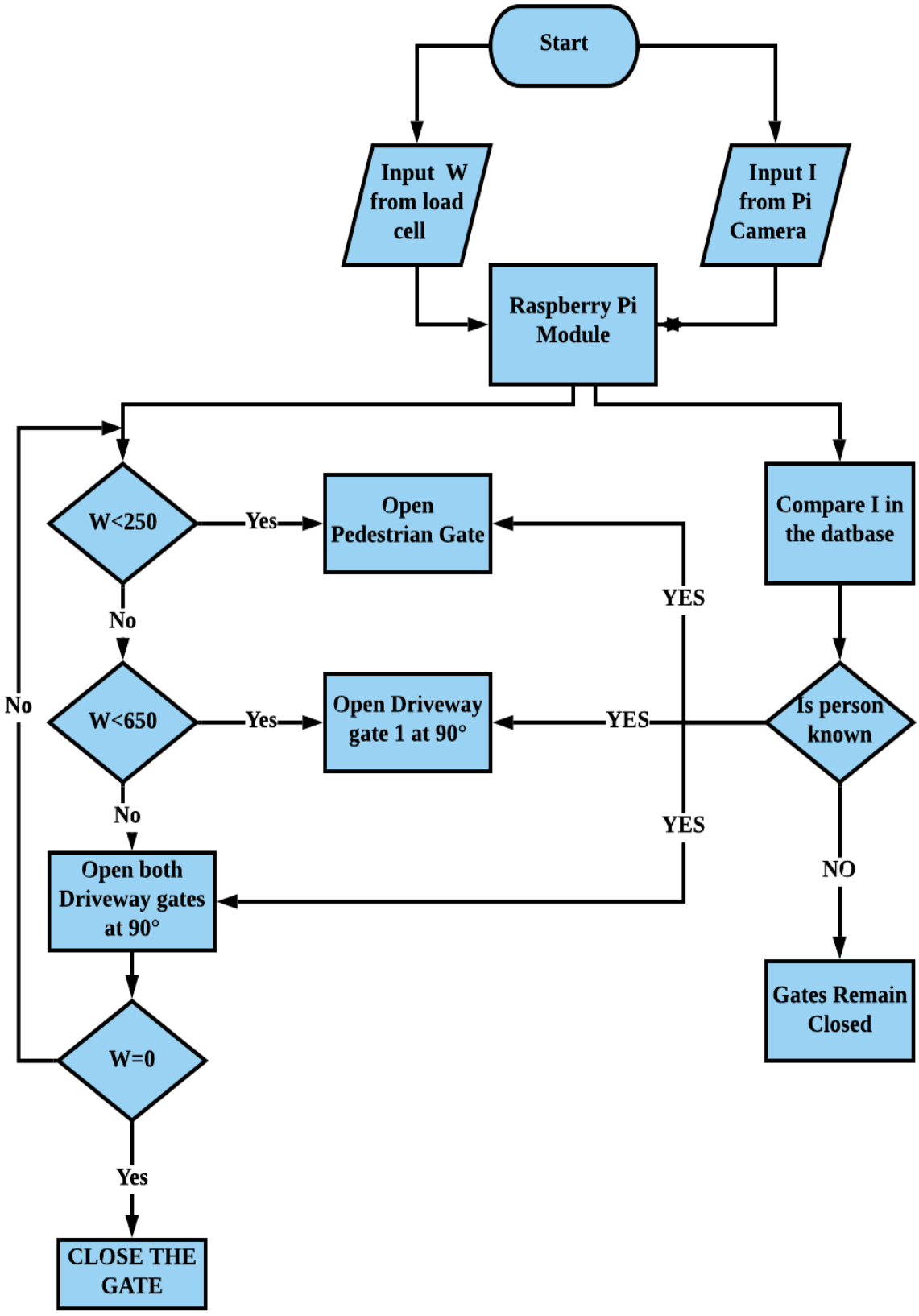

Fig 5. Operating Automatic Driveway Gate with Pedestrian Gate

CONCLUSION

Automation plays a very important role in our lives. But with the advancement in technologies, security also becomes another important aspect which is to be considered at every step. This proposed system helps us to automate the gates as well as provide us the needed security with the help of face recognition technologies. Further improvements in this system can lead us to incorporate the Internet of Things (IoT) which can make this system more functional and reliable.

REFERENCES

1) Ivan Muller, Renato Machado de Brito, Carlos Radhika Kamath, Mamatha Balachandra, And Srikanth Prabhu –"Raspberry Pi as visual sensor nodes in precision agriculture: A study" IEEE Access, Volume 7,2019
2) Harshada Chaudhari –"Raspberry Pi technology: A Review" International Journal Of Innovative and Emerging Research in Engineering Volume 2, Issue 3,2015
3) Radhika Kamath, Mamatha Balachandra, And Srikanth Prabhu – "Raspberry Pi as visual sensor nodes in precision agriculture: A study" IEEE Access, Volume 7,2019
4) Michel Owayjan, Amer Dergham, Gerges Haber, Nidal Fakih, Ahmad Hamoush, Elie Abdo- "Face recognition security system" Conference Paper, December 2013
5) Baina Kiran, L.Amarteja, Sk.Madarshareef, J.Bindhusekhar – "Motion based automatic garage door opener" International Journal of Engineering Trends and Applications, Volume 5 Issue 2, Mar-Apr 2018