Integrating Facial Recognition with Motion Capture using OpenCV and Raspberry Pi for Advanced Intruder Detection in Security Systems

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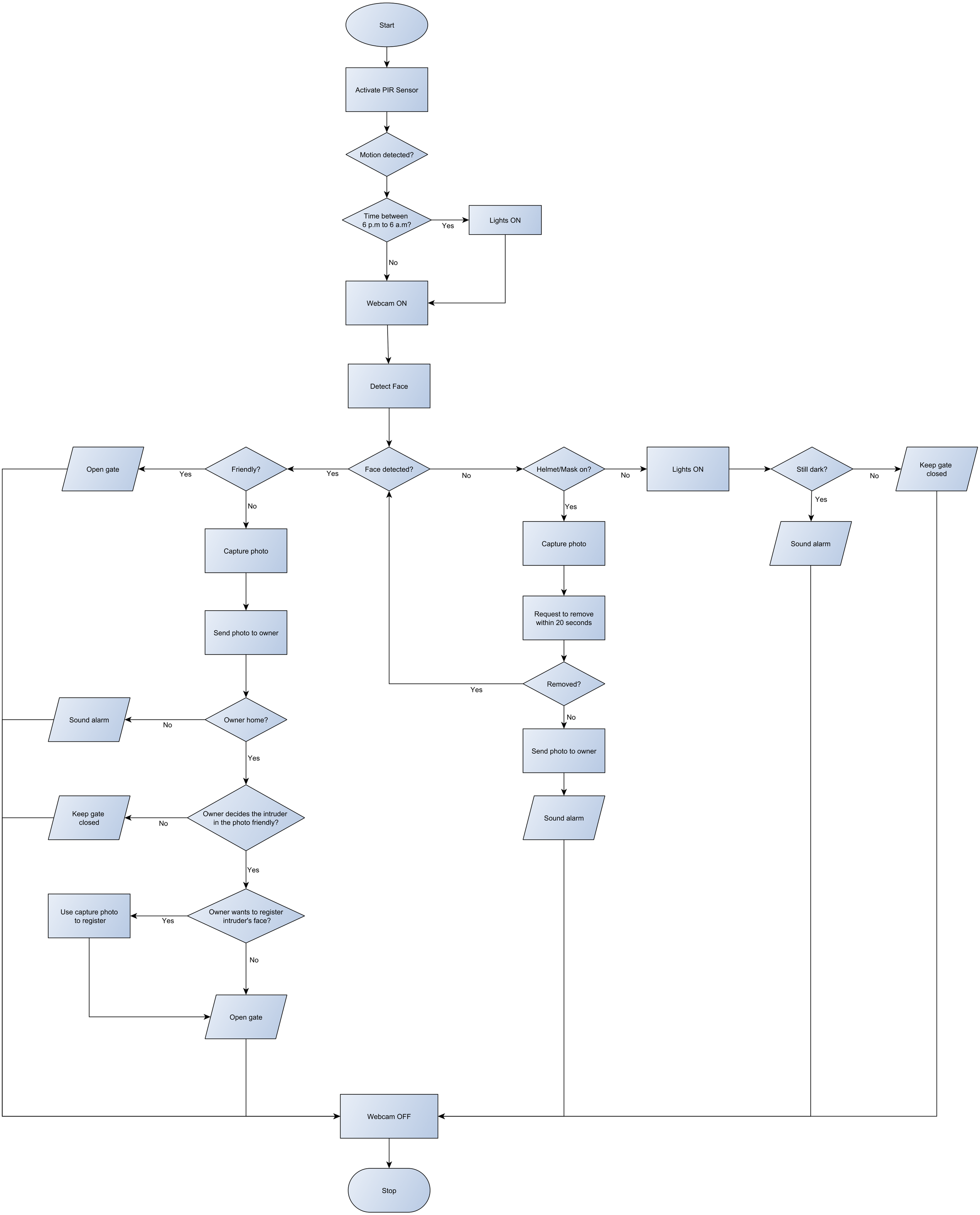
Abstract:

So far, many journals and conference papers have been published regarding home security systems. Among them, in a conference paper by Abhilash D et al. in 2017, a motion sensor was used to detect the intruder, which activated a webcam to detect a face. Once detected, an image of the face was captured and sent to the owner via email. Although this security system was energy and cost efficient, it had limited functionalities. This system did not recognize friendly faces, and might not have worked if the intruder had a mask or a helmet on.

The purpose of this project is to take the above limitations into account, and additionally introduce extra useful functionalities. Our system introduces face recognition, not just face detection, to detect if the face captured is friendly or not based on the data fed to the system initially. If not, the system sounds an alarm and captures and stores the photo of the intruder. Now, the captured photo is primarily used to catch the intruder. Otherwise, in case the intruder is friendly, say, a relative, the owner can choose to register their face so that the next time the relative shows up, the system recognizes them.

Furthermore, the system is embedded with a mask/helmet detection algorithm, which prompts the intruder to show their faces. If the intruder does not follow up to a given grace time, the alarm is sounded.

To add in a few more trivial yet useful functions, the system also has a light connected, which turns on as soon as motion is detected. This is mainly useful during the night. To save energy, the light turns on if motion is detected and the time is between 6 p.m. to 6 a.m.


Start
Activate PIR Sensor
Motion detected?
Time between 6 p.m to 6 a.m?
Yes
Lights ON
No
Webcam ON
Detect Face
Face detected?
Yes
Friendly?
Yes
Open gate
No
Capture photo
Send photo to owner
Owner home?
No
Sound alarm
Yes
Owner decides the intruder in the photo friendly?
No
Keep gate closed
Yes
Owner wants to register intruder's face?
Yes
Use capture photo to register
No
Open gate
No
Helmet/Mask on?
No
Yes
Capture photo
Request to remove within 20 seconds
Removed?
Yes
No
Send photo to owner
Sound alarm
Lights ON
Still dark?
No
Keep gate closed
Yes
Sound alarm
Webcam OFF
Stop