Intelligent Access Control for Safety-Critical Areas

1. Introduction:

1.1 Overview:

With the advent of Industry 4.0 various sectors of the industry have started to use Internet of Things in order to make things easier and increase efficiency and, at the end of the day, increase the profit margin. Security and monitoring is one area in which IOT can be easily be used in order to have remote monitoring and control.

1.2 Purpose:

The aim of this project is to we aim to ensure that all the personnel entering a safety-critical area are wearing the proper Personal Protection Equipment (helmet specifically).

2. Literature Survey:

2.1 Existing Problem:

Safety professionals are tasked with maintaining a safe workplace for employees. They must be able to assess risk in the workplace and develop and implement proactive measures that help prevent injuries and illnesses from happening in the first place. They must also be able to track, investigate, and manage safety incidents to identify ways to prevent future occurrences, but it is time consuming and needs human resource.

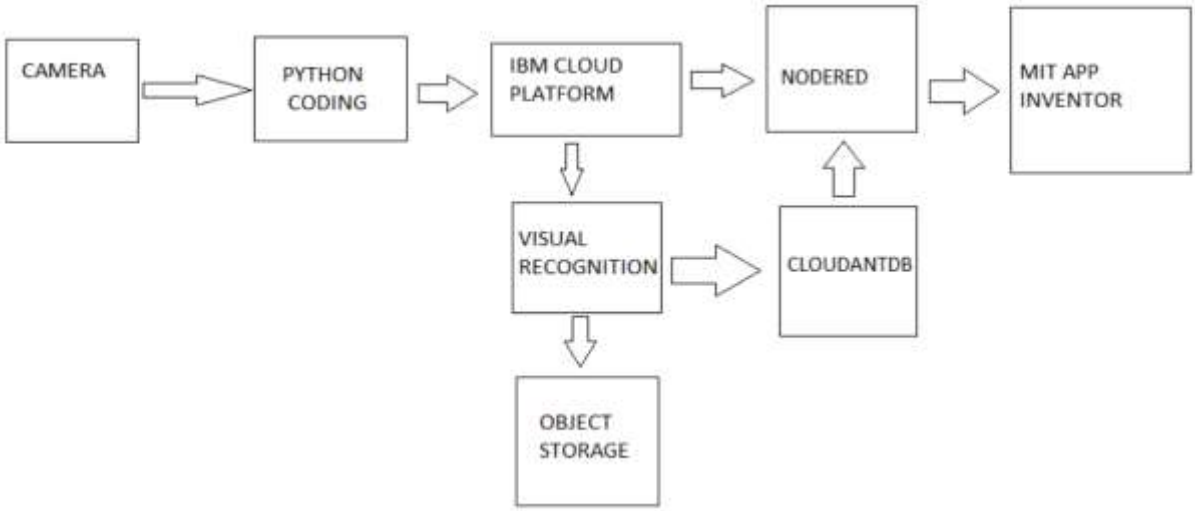
2.2 Proposed Solution:

Using IOT, we can capture images of any entering person and use services on IBM Platform in order to detect if the person is wearing a helmet or not and then open

the gate or issue a message asking them to wear one. The image is also stored in the cloud and can be accessed using a web application and a mobile app. This will not fully control the accidents but it will definitely address the issue.

3. Theoretical Analysis:

3.1 Block Diagram:



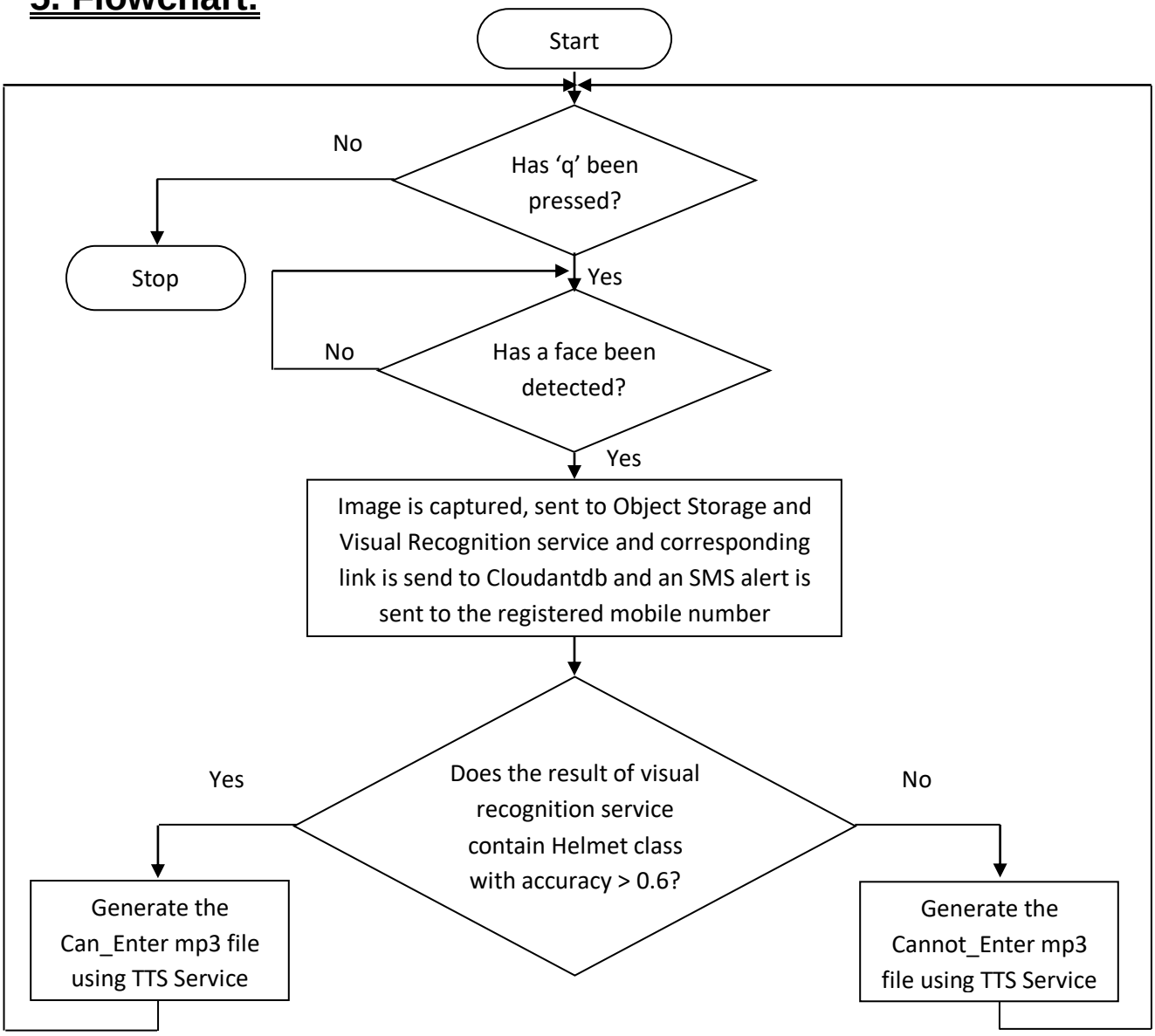
3.2 Hardware / Software Designing:

The hardware part of the project would ideally involve the Raspberry Pi 3 Model. Since that isn't available right now, this entire project has been implemented on the laptop computer. The webcam on the laptop is accessed using the python coding. Whenever a worker enters the camera's range their face is detected using opencv library an image is captured and an SMS alert is sent to the registered mobile number. This image is sent to IBM Cloud Object Service and using Visual Recognition service the presence or absence of helmet is detected and the result is sent to the python code which decides on a message. The python code then accesses the Text to Speech service to convert the message to speech form. The link to the images stored in object storage is sent to Cloudantdb. The image can then be viewed on the mobile phone through web application developed using node-red and on the app developed using MIT app inventor.

4. Experimental Investigations:

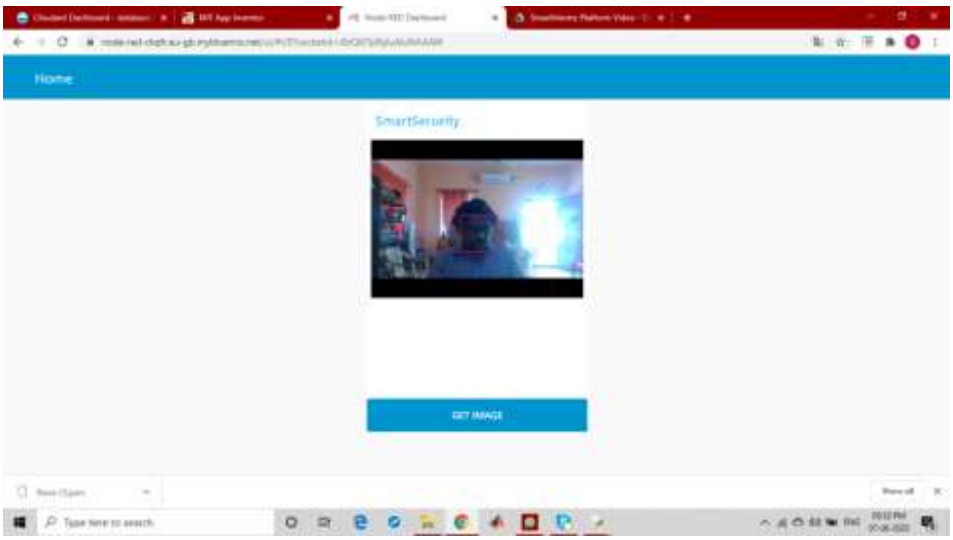
The working depends on the accuracy of the visual recognition service and in turn on the training data. Also the system has to be monitored frequently at least in the initial stages of implementation to make sure there are no errors. Since we do not access to a worker's helmet the test for the working of the project could not be tested completely, but even if there are any errors, they can be quickly corrected by editing and retraining the model on the visual recognition service.

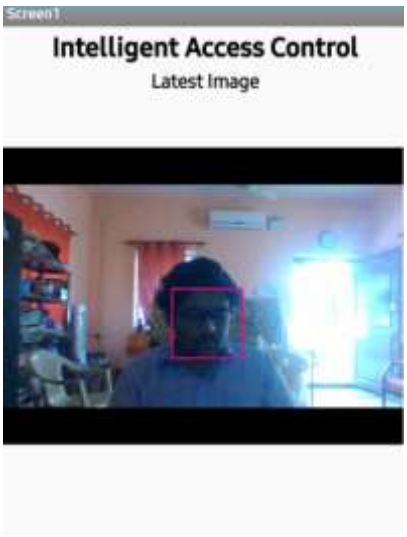
5. Flowchart:



6. Result:

The following outputs are viewed on the node-red based web application (left) and MIT App Inventor's AI Companion (right).





7. Advantages & Disadvantages:

Advantages:

- Reduces the waste of human resource for such busy work. The personnel can be assigned some other task.
- There is virtually no chance for error once the system is well trained.
- There is a log of the persons entering the site on the cloud.

Disadvantages:

- There is obvious loss of jobs.
- The system can be hoodwinked by someone holding the helmet in view but not wearing it.
- A public cloud service can be hacked so if the area is a very private area whose entry log is to be kept confidential, it would not be advisable to use the private cloud.

8. Applications:

Though the use of protective helmets is required in a very few areas, the application can easily be tweaked to detect all kinds of PPE. Common areas or hazards that will require a worker to wear PPE include:

- Extreme temperatures.
- Sources of electricity from equipment or machines.
- Harmful dust.
- Radiation.
- Lasers.
- Hazardous chemicals.
- Loud noises.
- Sharp objects that could cut, stab, or puncture.

9. Conclusion:

Thus the project can be used in safety critical areas in order to enforce the wearing of PPE (helmet) without the need of any human intervention.

10. Future Scope:

As stated under applications, the project can be extended any other kinds of PPE as well making it useful in any kind of situation where a specific dress code needs to be enforced. Also the web application can be extended to add continuous video streaming and also the authorized personnel can be given access to the gate to override the decision of the python code in exceptional cases.

11. Bibliography:

- G.Sowjanya, S.Nagaraju, “Design and Implementation of Door Access Control and Security System Based on IOT”, 2016 International Conference on Inventive Computation Technologies (ICICT)
- Antonio L. Maia Neto ; Yuri L. Pereira ; Artur L. F. Souza ; Italo Cunha ; Leonardo B. Oliveira “Demo Abstract: Attributed-Based Authentication and Access Control for IoT Home Devices” 2018 17th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN).